FASHION

INSTITUTE

OF TECHNOLOGY

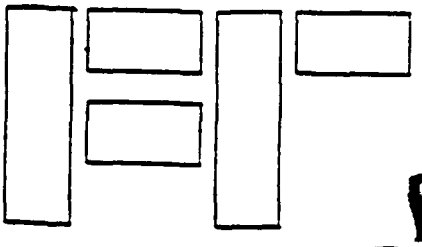
RESEARCH REPORT

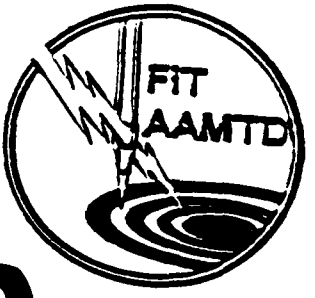
ANALYSIS OF GARMENT PRODUCTION METHODS

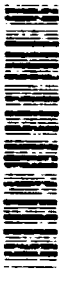
PART II

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

Fashion Institute of Technology







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ANALYSIS OF GARMENT PRODUCTION METHODS, PART II: Comparison of Cost and Production Between a Traditional Bundle System and Modular Manufacturing.

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000301

Defense Logistics Agency
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This document is Part II of three parts, each of which will be published separately.

Unrestricted

The objective of this project was to compare the costs and productivity relationships between the Traditional Bundle System method of apparel production with the new Modular Manufacturing System.

The project was divided into four parts which ran concurrently: 1) analysis of Traditional Bundle Systems; 2) observation of installation and shake-down of two Modular Manufacturing Systems; 3) analyses of Modular Manufacturing Systems; and 4) comparative analyses of Modular Manufacturing and Traditional Bundle Systems.

Major conclusions drawn are: Modular Manufacturing requires total management commitment; decision-making pressure on management and supervisors increases as the role of the supervisor changes; complex garments can be made by using multiple modules; work-in-process is significantly reduced while finished product quality improves; the ideal module consists of 3-5 operators whose earnings are potentially higher. Other conclusions are also discussed.

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Apparel, Traditional Bundle System, Cost Data, Production Data, Modular Manufacturing System

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ADVANCED APPAREL MANUFACTURING TECHNOLOGY

FASHION INSTITUTE OF TECHNOLOGY

DLA900-87-D-0016-0003

ANALYSIS OF GARMENT PRODUCTION METHODS PART II

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

FINAL TECHNICAL REPORT A008

Aaron Schorr
Project Leader

January, 1992

This project has been sponsored by the
DEFENSE LOGISTICS AGENCY
CAMERON STATION
ALEXANDRIA, VA 22304-6100

EDITOR'S NOTE

The Final Technical Report A008, "Comparison of Cost and Production Between a Traditional Bundle System and Modular Manufacturing", is the second part of a series of three reports to be issued under DLA900-87-D-0016-0003.

Part I of the series is titled, "Comparison of Cost and Production Between a Traditional Bundle System and a Unit Production System Installation".

Part III of the series is tentatively titled, "Integration of a Carousel Module in a Unit Production System".

PREFACE

When we initially sought to have this project approved it was because we did not feel that the true story of modular manufacturing was being told. We believed that it could be a significant addition to our arsenal in the development of flexible manufacturing for military and civilian apparel, but we felt that there had to be more approaches than kanban, the Japanese developed modular configuration that has all of the operators standing with the work being pulled through from the last operation (consumer) instead of being pushed through from the first manufacturing operation.

We hoped that by closely monitoring two firms undergoing the transition from progressive bundle to modular manufacturing that we, as researchers, could learn from direct observation and pass that knowledge to others. We also saw this project as an opportunity for our manufacturing management students to see first hand how companies respond to changes in their economic environment.

We are quite pleased with the level of cooperation that we received from both of the firms participating in this study and wish to thank, from Triple A Manufacturing: Mr. Irwin Alperin, and the employees; and from Allison Fashions: Mr. Sal Italiano and his employees.

It is obvious from the meetings that we have attended that this is an important topic and has tremendous implications with Quick Response. Most people are beginning to recognize the advantages of reduced work in process, but they are just learning about the human relations aspects of modular manufacturing and how to manage it.

We look forward to the possibility of extending the work done here into the important area of employee preselection and training. Preliminary indications are that we can predict success within the production process. We would look to prove that in future research efforts. If we can, then the cost savings to employers, and potentially consumers, would indeed be significant.

My personal thanks and congratulations go to the research team who assisted in authoring this report. I would also like to thank Mr. Donald O'Brien and his staff at the Manufacturing Engineering Research Office, as well as others at, the Defense Logistics Agency of Cameron Station, Alexandria, Virginia for actively supporting this project and promoting this type of applied research.

Aaron Schorr

December 4, 1991

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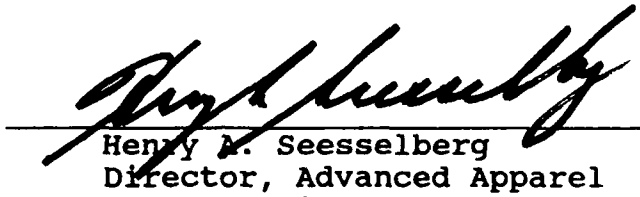
It is hereby submitted to the DLA office (DPMSO), Cameron Station, Alexandria, VA 22304-6100 in accordance with the Contract Data Requirements List, sequence A008.



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We appreciate the cooperation of the following individuals who participated in this project.

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Mr. John Vohls
Mr. Joe Scarpo
Ms. Dianne Brown
Employees of Triple A Manufacturing Co., Inc.
Mr. Sal Italiano
Employees of Allison Fashions

This Project was sponsored by the Defense Logistics Agency, Cameron Station, Virginia, under contract number DLA900-87-D-0016-0003.

A.1. INTRODUCTION

Modular manufacturing is the latest business strategy to be embraced by apparel companies in this country as they seek to remain competitive in an increasingly hostile international business environment.

The classic definition of modular manufacturing offered by the Apparel Research Committee of the American Apparel Manufacturers Association in September of 1989 was:

> A contained, manageable work unit of 5-17 people performing a measurable task. The operators are interchangeable among tasks within the group to the extent practical, and incentive compensation is based upon the team's output of first quality product.

It qualifies as a strategy because when a firm considers modules, the planning phase involves an evaluation of human resources, available capital, sales plan, training capability, organization, flexibility, quality control, physical space, how to encourage employee participation, fit with just-in-time philosophy, and method of compensation. It is not just limited to technology or simply placing equipment in some new configuration.

We have spent the last year observing two firms as they experimented with modular manufacturing. The following report will track the progress of each company. We felt it was advisable to present a brief history of each and then a time line synopsis of each so that you might better understand the transitions as they moved through the year. Incorporated into the analysis is the statistical interpretation of data collected from each firm, as well as a discussion of group dynamics. (See Appendix G for a general overview of Group Dynamics.) We will also identify some of the unanswered questions we have uncovered during this investigation that we feel merit additional research.

This is, therefore, the story of two companies who decided to convert to modular manufacturing from progressive bundle operations. The first company converted the complete factory while the second changed one of three lines in it's facility.

A.2. PROJECT OBJECTIVES

The objective of this project was to observe the transition of the two firms and evaluate the costs, successes and/or failures of the two dissimilar contractors in applying the existing theories of modular manufacturing to their own firms. These firms represent typical contractors/manufacturers. The knowledge gained from their experiences could assist others as the industry moves to develop flexible strategies for Quick Response.

It was our belief in beginning this project that a module consisted of a group of associates working together as a team to produce a first quality subassembly or complete product. We did not believe that an entire plant had to be modular in order to take advantage of this manufacturing approach.

A.3. SUCCESSFUL MODULE CHARACTERISTICS

We have since concluded that a successful module has the following characteristics:

- Strong teamwork among 3 or more people.
- Good communication between employees and management.
- An organized training program for operators to learn multiple operations within the module (minimum of 3).
- Commitment from management to make it work and to provide necessary resources.
- Flexible workers.
- Motivation by fair compensation.
- Low work in process inventory.
- Low or no absenteeism
- High quality standards.

It is our contention that success is not guaranteed simply by allocating resources and announcing that a firm is now modular. It must be a planned strategy.

B.1. ALLISON FASHIONS

B.1.1. Historical Overview. Allison Fashions was started by an uncle of Mr. Sal Italiano, the present owner. Allison began as a childrens' wear manufacturer and later switched to dresses and ladies' sportswear. Today it produces ladies' blazers.

In 1960, Mr. Italiano's father came into the business; he eventually became partners with his brother. He retained control when his brother (the founder) left the business. They have always been contractors. In 1977, Sal Italiano came into the business and at that time they had already been producing blazers. In the early 1970s the company doubled in size. Sal's father retired from Allison Fashions in 1980.

Allison Fashions is a manufacturer of fully lined ladies' blazers (Figs. 1-2, and Appendix C). The owner decided, in order for his company to survive in today's economic climate, it was essential that they convert from their progressive bundle system to a modular manufacturing system. Prior to converting, their operators worked at an hourly rate based on the operator's experience and the difficulty of the operation. With the conversion, they changed to an hourly rate with a group incentive. The percentage of the incentive was based upon units produced above the norm on a weekly basis. The operators participate in the development of their goals. They estimate the number of pieces that they can produce for a given style and negotiate the final number with management. This final number is then used in the costing analysis of the style to assure profitability.

B.1.2. Monthly Activities.

JANUARY

When this project began in January, 1990, Allison was in the process of converting from a progressive bundle system to a modular system. While functioning on a bundle system the plant was set up with the machines in rows all facing in the same direction. With the conversion to modular manufacturing, the machines were arranged in circles with the operators facing outward. Underpressing of seams, darts or other parts was done in the middle of the circles. There were three circles - small parts, subassembly, and final assembly. Machines were placed in the circle in the order of the flow of work. Sorting was performed in a separate area. Buttonsew and buttonhole operators had the option of either sitting or standing. Buttonhole, buttonsew and final pressing operations were performed away from the three circles (Appendix D).

The plant personnel consisted of 50 operators, a plant manager, a lead (utility) operator, and the owner. This remained the same from the previous system to the modular system. There is no mechanic available on the premises. The owner and plant manager perform minor repairs and adjustments.

Under the progressive bundle system there was no prior training of operators. Operators were trained one-on-one (one operator trains another) with the plant manager overseeing the progress or lack of it. Several operators are cross trained to perform several operations. The method of training has remained the same with the conversion to modular manufacturing. A goal of management is to have lower skilled operators advance to higher skilled operations. New operators can then be hired and do their training on lower skilled operations. The ultimate goal is to have the entire workforce cross trained to perform several operations.

Under the bundle system there were 3-4 trim and inspect personnel who visually inspected the garments. It was hoped that by converting to modular manufacturing there would be an improvement in finished quality. The criteria to be considered were: the number of repairs, appearance, and overall consistency in worker performance achieved by adherence to specifications.

From the beginning of the conversion, the workers were comfortable with the new set up and liked the new flow of work through the factory. Management wanted to have the work circles compete against one another in order to motivate and increase productivity. The results of each day's efforts were posted on a daily basis. Initially, the winning group was rewarded with the option of earning extra wages or leaving early on Fridays. This incentive has changed several times during the year.

FEBRUARY

The most noticeable change this month was the introduction of the new ergonomic chairs for the operators. Previously the operators were sitting in an assortment of chairs that were not very comfortable. These old chairs were changed to new and comfortable Aflex brand chairs. Aflex chairs are cushioned on the bottom and back and support the operators' spines in a comfortable position.

Mr. Italiano purchased these chairs when he saw them at the 1989 Bobbin Show. We noticed that this gesture improved the attitudes of the operators. They saw that management was trying to make the work area more comfortable. It was hoped that this would improve their productivity. Productivity did increase, but it could not be determined how much was because of the chair and how much was because the operators were receiving more attention.

A change was made in the plant layout. The fusing machine was moved from the back corner near the pressing machines to a side wall closer to the small parts assembly. This helped to cut down on handling time by placing it closer to the assembly circles where it was needed.

The intermediate trim and inspect operations which were performed before the pressing operations were eliminated. There now is only one final trim and inspect operation which is at the end of all of the sewing and pressing operations. Workers performing the intermediate task have been reassigned.

A new incentive program, shown below, was put into effect during the month. The number of pieces finished per week determined the bonus percentage the operators would receive.

Note: For confidentiality, the numbers shown are for example only and do not necessarily reflect actual production numbers. For example: an operator who earned $320.00 a week ($8.00 per hour) would receive an extra 5% bonus if total production was between 1,000 and 1,099 pieces for that week. In other words, she would have received a bonus of $16.00.

The incentives were:

Pieces/Week	Bonus
1,000 - 1,099	5%
1,100 - 1,199	6%
1,200 - 1,299	8%
1,300 - 1,399	10%
1,400 - 1,499	15%
1,500 - 1,599	20%
1,600 - 1,699	25%

On January 29, the incentive program went into effect. In the week previous to the 29th, the operators produced 725 pieces. The week after the 29th, they produced 1,266 pieces. This was almost a 75% increase in production. We believed that this increase was caused by many factors, the most significant being the changeover to solid color jackets:

* Switch from plaid to solid jackets.

* The arrival of new chairs.

* The addition of the incentive system.

At this point the firm was beginning to realize an increase in production while experiencing the beginnings of a decrease in work in process.

MARCH

We tracked the progress by monitoring production counts which were performed hourly. In order to monitor training we also performed time studies on the following operations:

* Attach lining to bottom with wiggan.

* Attach lining to body.

* Sleeve setting.

* Run basting.

* Trim and inspect.

During March, work in process decreased dramatically from 50 -60 pieces per operation, to less than 10. The plant exceeded the production goal of 260 pieces per day. The company had experienced a 25% increase in productivity since the beginning of the year using the same number of operators.

The operators were working as a team in order to increase output. They were sharing ideas and minor decision making within the groups. They were helping each other. The operators were even conducting their own meetings in order to keep the circle running smoothly, but management, at this point, did not believe that the employees were capable of tackling complex problems.

In order to motivate the operators to perform at their full capacity, management offered the operators the following incentives:

* The team that produced the most units for the week received a free cake on the following Monday morning. (This incentive has been maintained.)

* If a group met their quota beforehand, they could leave early for the day and still receive the full day's pay.

* Mr. Italiano considered giving bonuses or gifts to operators with outstanding quality and attendance records. (This was never put into effect.)

* Mr. Italiano believed that the pressing department could be more productive and offered all workers in the unit an extra hour of pay if they would produce the same amount of work with one less person. They did, and one person who had resigned from the pressing department was not replaced.

APRIL

Time studies were continued in April for sleeve setting, attach lining to body, attach lining to bottom of body, pocket welts, and trim and inspect.

The following changes occurred in the assembly circles:

* Mr. Italiano decided that the larger assembly circle should be broken up because of personality conflicts and problems the members were having with their sense of teamwork. Fifteen people in one group was considered too large. The goal was no more than 7-8 at that time. The group also had too many operations. Even though the group was divided, physically it remained in the same area.

* One more incentive had been added to attempt to have everyone start work on time. If one whole group began its work on time, for a whole week, there would be a raffle within the group. The winner would receive one week's worth of subway tokens. (This incentive did not work and was discontinued.)

* A new mini-boiler was bought for the pressing operations and was placed in the middle of the production circle. This was an added expense but it eliminated transporting garments to another area and it improved the underpressing and overall garment quality.

* The operation of capping sleeve was changed slightly in order to improve the quality: tape was being inserted to allow the sleeve to lay nicer and be sewn evenly.

MAY

Since the subassembly circle was divided into two groups last month we noticed that the production of the two groups increased and that communication within the groups improved. This month they posted chalk boards in front of each circle. The hourly production was posted on these boards so that each group was aware of the production of the other groups. Management hoped that this visual display would boost competition between the groups and increase production.

The owner also considered hiring more people to work the subassembly circle because the team felt they could not produce additional units with the same number of workers. The subassembly circle also considered incorporating the fusing department into their own team in order to increase their incentive.

We noted that lateness and absenteeism had not improved despite efforts to develop some incentive that would overcome the problem.

JUNE

Our primary focus in June was the evaluation of incentive programs. Incentives are productivity oriented.

In April, in an attempt to get the workers to start work on time, the owner started a raffle. Each group that came in early and started it's work on time would have a raffle. The winner of the raffle would win one week's worth of subway tokens. This, however, didn't work because the operators were not willing to come in early.

Another incentive that Mr. Italiano had developed in March was a party cake. A cake would be given on the following Monday to the group with the highest productivity during the preceding week. This incentive was successful, so variations were tried, such as free sodas at lunchtime for the week. One or another of these variations is still in effect.

The chalkboards, which were previously mentioned had a positive effect on the workers because they were now able to immediately see how they were doing compared to the other competing groups. They were also able to see the percentage of bonus money they were earning. Bonuses have since been replaced by gain sharing under a new pay system introduced in 1991.

Allison Fashions had by this time demonstrated overall improvement since the changeover in January. When groups worked on large lots the plant met its weekly required plan. The operators were also able to keep the number of pieces at a work station to a minimum, sometimes as low as 5.

The operators were not able to cope with changing styles at their stations. On our visit, the factory had about four styles going through at once. With this number of changes in styles, some operators had as many as forty pieces at their stations which resulted in unbalanced production and confusion. Mr. Italiano and the plant manager had to personally direct all of the operator groups to keep the work flowing.

Other changes within the factory that were noted at this time are as follows:

* The subassembly circle had been divided into a group of 7-10 operators. This size group seemed ideal. Previously, this subassembly group had 14 operators but in May it was split into two circles. This split setup worked fairly well while larger lots went through, but when shorter lots and style changes were more frequent the group seemed less flexible. By month's end they returned to the original subassembly arrangement of 14 in a group and then, in the fall, divided again into smaller units of 3-5 operators.

* Despite the efforts of management, the different operator groups had made no attempts to unite themselves and involve themselves in decision making. More efforts will have to continue to be made by management to encourage the operators to do so in the future.

* The labor turnover rate had been held to a minimum. Since the incentive system went into effect they had had two operators quit and one operator had been fired because of her lack of flexibility and cooperation.

JULY

It was noted that there had been problems in the switch to the modular system, particularly when it came to style changes. The solution appeared to be the use of a utility operator to be able to move from unit to unit without penalties for the group incentives. The group incentive was still strictly tied to the output of first grade units finished in the shop. This insured that repairs were not double counted.

In July we did not anticipate any additional major changes in the plant layout or operator compensation but it was apparent that Mr. Italiano intended to look for better systems. To this end he was determined that he would attend the Bobbin Show and meet with others who were involved in modular manufacturing.

AUGUST

We noted at this time that there had been a settling in from six months of effort. The circle approach seemed to be working well and allowed work in process to be reduced to pieces between operations instead of bundles or hampers. The operators had responded well to the implementation of the group incentive system. It also appeared, at this time, that management would not be able to step back from decision making within the groups, particularly when there were style changes within the production cycle. Also on the positive side, the firm had already reaped the benefits of increased productivity, improved quality, and decreased work in process, and operators had started taking it upon themselves to handle small problems or production shifts on staple products.

These improvements gave the owner the time to look at other aspects of the business such as planning for expansion, looking at profitability and evaluating the full capabilities of the plant.

SEPTEMBER - OCTOBER

Management had reached a comfort zone with their modular setup and had gained a better understanding of how it works. They were finding what type of work they can and cannot do without disrupting the entire process.

A continuing concern was finding ways to motivate the operators to take on more work or responsibility within their smaller modules and how to handle style changes within their groups.

NOVEMBER

Mr. Italiano found that two of the work circles were too large, thus making it difficult for the operators to develop cooperation. As a result, the circles were broken up into two groups each. In doing so, it became evident that it was inefficient to have the sections remain as "Parts Make", and "Sub-Assembly". Therefore, all five groups were reconstructed as follows:

* Fronts Section - makes the front and sets the pocket.
* Back Section - makes the back and attaches the front at the shoulders, then makes the sleeves and sets the sleeves.
* Facing/Collar Section - makes the facing and sets it, makes the collar and sets it.
* Lining Section - makes the lining then sets it into the body.
* Final Section - does the topstitching, turning and cap stitching.

This system had a logical flow that progressed through the assembly of the garment. It was a great improvement over the previous system which was illogical.

Mr. Italiano also adopted the Clemson Apparel Research (CAR) system of compensation (Appendix H), abandoning the group percentage bonus method used since February. This system seemed to provide better cost-to-profit coordination on a style-by-style basis. Only two styles had been processed using this system, but initial reaction from the operators was good.

FOLLOW-UP

The firm has continued to make progress in many areas. At this time it appears to be a success story despite the current economic environment. The conversion to modular manufacturing has been timely as the firm is now able to:

* Produce garments in days instead of weeks.

* Improve the quality of the finished garment.

* Predict profitability.

The final layout varies from 5 to 7 groups depending on the garment being manufactured. Operators make their parts, then join them to the main body within their group.

The inspection procedure has also been changed. Now an inspector examines the blazers prior to pressing and returns defective work to the operators on an hourly basis. This has cut the errors found at packing to zero.

Management is still not completely satisfied and is looking forward to further developing their business. This year may see the introduction of a personal computer to begin collecting production and cost data for the owner. The aim is to assure the financial stability of the firm through accurate costing, measurement of employee productivity, and allocation of income and expenses.

B.1.3. **Statistical Summary.**

B.1.3.1. Productivity. Random time studies were performed which seemed to confirm that the operators were responding to the group incentives that were applied by management. The efficiencies are not equal to what we have seen in factories that have a long history of individual incentives. The firm has been able to benefit from a higher level of productivity and quality with its switch from progressive bundle to modular construction.

B.1.3.2. Cost Summary.

Item	Cost	Saving
Payroll	5 hours clerical per week	
Additional Equipment	$5,000	
New Operator Training	Takes 5-6 new to get 1 good. Higher than before modular.	
Work in Process		Reduced by 66%. Throughput reduced from 21 to 10 days.
Modular Seminars	$2,000 attendance	
Transition Planning	1 week by owner and plant manager	
Physical Layout Change	1 weekend by owner and plant manager	
Training Cost	Unknown. Employees are paid hourly, records not available.	
Production		Doubled per modular levels.
Profits		Utilizing CAR analysis, management is now capable of predicting profits and avoiding losses.

B.1.4. **Group Dynamics**. This firm has many cultures mixed in a small population. Language is not a problem as the owner is bilingual. The company has historically been one with operators earning an hourly wage based on longevity and skills. Management contact has always been direct as the owners have never had intermediaries running the factory. Their personal presence has been standard operating procedure passed from father to son.

In the progressive bundle environment the operators had no incentive for quality or productivity improvements. There was no specific interaction among operators that was work related.

When the firm switched to the circles and broke the work force into smaller units the owner began to see some immediate improvements. It is a recognized fact that when employees feel that special attention is being paid to them they will respond (Hawthorne Effect). There will also be a normal 20% increase in productivity when incentives are applied in an hourly only environment. At Allison these results were exceeded with increases of over 40% being consistently achieved. There has been positive response to group incentives such as cake rewards and the posting of production achievements for all to see. The groups enjoy the competition during the day and the owner and plant manager keep encouraging each group to outproduce the others. They act as cheerleaders and reporters as they post the production counts on an hourly basis. They make it a point to bring everyone's attention to superior performance.

Not all, however, is going according to plan. The desired self-management, participation in minor problem solving, and the establishment of team objectives are goals that have not been met. The operators have been reluctant to accept the offer of participation in self-regulation and task direction. Cultural variations within the groups seem to block cooperative efforts towards problem solving.

After evaluating the workforce by means of a questionnaire that was administered, we can predict that the groups will never be autonomous nor will the operators be involved in the planning and control aspects of the modules. Those responsibilities will be left to management.

B.1.4.1. Work-Needs Assessment Inventory. In an attempt to understand the importance of small group behavior in the success or failure of this exercise, the Work-Needs Assessment Inventory (Appendix A) was administered to the employees of Allison Fashions at the beginning of our study. The questionnaire was translated into Spanish for those employees requiring it. The conclusions listed are from the time of the test. As you will see from the information gathered during this project, the test seems to be a valid predictor of group behavior. The comments following the table were taken from a monthly project status report. When you couple our predictions with the project's chronology, as outlined in section B.1.2., you can see why we would be interested in examining this concept in more work

environments - to see if we get consistent results. It is the opinion of this research team that modular workplaces are not for everyone. If a tool can be developed which could predict which environment is best suited for an operator, then we can possibly save on training, absenteeism, lateness, make-up and other related costs.

Discussions of work-needs assessment theory are contained in Appendix A and Appendix G.

TEST SCORES

EMPLOYEE	ACHIEVEMENT	AFFILIATION	POWER
1	38	26	44
2	25	26	31
3	7	6	6
4	13	15	16
5	24	23	20
6	38	26	42
7	36	27	27
8	4	11	2
9	2	11	4
10	6	7	4
11	5	6	7
Total	198	184	203

Organization Behavior Predictions.

As noted in June 1990's monthly report, the information from this company's operators cannot be analyzed in the normal manner. You must look at each person and his or her response relative to how he or she responded to other questions.

One of the problems of this company's conversion to modular is evident from this exercise: communication. It is apparent that even though the questions were in Spanish for the employees benefits, the comprehension was low, cooperation lacking, and the operators' understanding of what was happening at the company is questionable.

Response of any type was only 20% for the operators in the company. From those that did respond you can surmise that there is no consistency among the employees as to which area is more important among the three tested.

It is our impression that the management of this firm will have a hard time pulling back from the groups and permitting them to govern themselves. It appears that the groups will continue to look to management to step in on style changes and direct the activities of the operators, as well as handle other problems within the groups. There are leaders within the groups who are looking to the incentives for increasing earnings, and are looking for the power to lead, but it appears that they will lead only when conditions are stable and not when change is involved.

B.2. TRIPLE A TROUSER MANUFACTURING CO., INC.

B.2.1. **Historical Overview.** Triple A Trouser Manufacturing Co. Inc., is an affiliate of Alperin Inc. Which is a family owned and operated mens' and boys' contracting, warehousing, and distribution business. Triple A was founded in 1946 by Mr. Louis Alperin, now deceased. At present, the principal officers of the corporation are: Meyer M. Alperin, Irwin E. Alperin, and James Alperin.

Alperin Inc. has grown from one division to seven and is now one of the largest apparel contractors in northeast Pennsylvania, employing 550 people as of May 1990.

Triple A employs 150 people and is located in Scranton, Pennsylvania. The plant was set up in three lines to produce various styles of boys' casual and dress trousers (Fig. 3, and Appendix E). The company has continually sought to improve its competitive position by investing in facilities and equipment which improve productivity and upgrade quality.

One of the most recent improvements at Triple A has been the implementation of a real-time data collection system from Redi Facts and a management reporting system from Magnal Facts. In addition, the firm has been investigating computerized cutting while gaining firsthand knowledge of the advantages and disadvantages of modular manufacturing. The management of Triple A is looking to position the company in the Quick Response business environment through the utilization of new technologies and information systems.

By the fall of 1989, Triple A discovered that its customers' needs had shifted and it was forecasting less than half of the then current production level of better boys' trousers. Although consideration was given to dropping this product line, key customers requested that the line be continued as it was needed by them in order to sell the basic Triple A line of trousers. Consequently, management decided to shift to a modular manufacturing system for this product's production. This line is identified as the Red Line.

B.2.2. **Monthly Activities.**

JANUARY

In January of 1990, when we began our project, the Red Line was still on a progressive bundle system with 24 operators, 1 utility operator, and 2 supervisors. The management of Triple A had been meeting for several months as they researched modular manufacturing and developed their objectives. Their goal was to have 9 to 11 operators on the line and to have the transition to modular complete by the end of February 1990. It was planned that the make belt loop, soabar, hemming, and make zippers operations were to remain outside the module.

All operators on the Red Line progressive bundle system were asked if they wanted to volunteer for the modular system. If they did not, they would be given their choice of other jobs available on the other lines in the shop.

When changed to the modular system, management hoped to achieve zero percent defects. The group of operators would have to be willing to work together as a team; each operator would need to know at least three operations; and, each operator would have a history of no absenteeism. There were to be no floor people and no final inspection of the garments. The whole team would be responsible for making a pair of pants, as opposed to the progressive bundle system where the operator just worries about the operation he/she is performing. The operators would check their quality and since the whole group would be responsible there would be "following neighbor" examination. To help make this transition from progressive bundle to modular, there would be meetings on company time to discuss methods of improvement. The meetings were anticipated to occur weekly or biweekly.

The shop has a computerized tracking system called Redi Facts which has a data collection device at every work station and which operates well in a progressive bundle system. The management at Triple A wanted to continue to use it in the modular system. An additional objective was to keep the piece rate incentive and have the operators earn at least their present wage, preferably more.

FEBRUARY

There was no contact between the research team and Triple A during February.

MARCH

Substantial changes had taken place by this time in the Red Line. The line had been reduced from 24 to 15 operators. Although the number of operators had been substantially reduced, the Red Line was making use of the same amount of space. The next step at Triple A would be to condense the Red Line so that the other lines could expand in that space (Appendix F).

In a meeting with operators and supervisors, management stressed the importance of teamwork with the goal of self management. The aim was to use supervisors as coaches rather than bosses. The operators questioned whether management had developed guidelines for the length of training for each operation since each operator was to learn two to three operations. The operators reminded management that they did not work on an operation for a full day so guidelines should be lenient in order to insure fair compensation.

Management raised the possibility of changing the present piece rate system to piece rate with group incentive. The operators did not respond favorably to this suggestion. The operators expressed concern regarding equipment problems; they complained about consistent breakdowns. Management responded by requesting that equipment from another plant be moved to Triple A to eliminate the problems and promised to check out the response time of the mechanics.

At a subsequent meeting the cross training pay system was discussed. The compensation system that was presented and used was the midpoint to midpoint system. Management explained that the midpoint system is defined as taking an average of the operator's average earnings and the current base rate. At Triple A, the midpoint to midpoint system is done by taking an average of the operator's rates for a time span between one holiday and another holiday (ex. 13 weeks), add a company defined rate of $5.00 to the average, and then divide by 2. This figure determines the new target rate at which the operator shall be paid. An example of how an operator could be compensated through this midpoint to midpoint system could be as follows: let's say an average rate per hour for the last holiday period was $6.00 and for this holiday period is $6.50. The average of these is $6.25. Now, add the $5.00 predetermined rate and divide by 2. The operator would be guaranteed $5.63 as his/her new average wage. This rate would always be higher than the factory guarantee, but less than an operator's average on incentive. The operators objected to this new system, but were willing to work with it until a new incentive plan was devised and implemented.

Another problem brought up at this time was the poor quality of the cut goods received from the cutting room. One operator was given the authority to act as spokesperson and bring the problem to the attention of the cutting room.

Management and operators discussed the layout of the modular line. The operators were asked if they would rather be facing each other or not. The operators brought up an important advantage of facing each other: they would be able to quickly spot any problems or back ups. Also, the operators suggested that there be no permanent leader for the group but that leadership would be rotated among them according to the nature of each problem being solved.

There was also discussion regarding bundle size. The operators suggested reducing the size of the bundles to less than 25 ply because larger bundles are too heavy to carry.

APRIL

Triple A's reason for going modular with the Red Line was an expected drop in sales and, therefore, in production for that line. By April, that reduction in production had not been realized. Therefore, in order to make a drastic change in the floor layout, production would have to be lowered by another 17%.

That was not happening. However, a few changes that could be made had been made, for example, the beginning of the production line machines were arranged in a "V" and the operators were no longer facing each other. More changes were expected before the final layout was realized. The operators were comfortable with the layout and their ability to move the work through the line.

The pay system had been altered to make up for pay lost while the line was in transition. The system was a combination of a guaranteed training rate and the midpoint to midpoint system. It was to last for 3-4 weeks. This system encouraged the operators to improve their efficiency, become familiar with the operations and not lose money. It appeared that this system would be most beneficial to the operator with a low average, but it would have some negative impact on an operator with a high average.

MAY

The sales/production level of the Red Line was still 25% higher than the original forecast per week. In order to keep up with production the Red Line had to borrow labor from outside the line. Other changes that were necessary to meet production were:

* One employee was temporarily assigned to the Red Line as a utility operator.

* Back pocket operations were done on another line.

* A sister plant pitched in on one style of pants because they had a special machine set up that is not at Triple A, thus making it more cost effective to spend the labor hours outside of the Red Line.

Further changes had been made in the layout: the fuse band machine was moved in front of the line; and some machines had been removed. The front grouping of machines in the "V" shape was funneling work into closing and subsequent assembly operations.

During a group meeting the following topics were discussed:

* Shelves were needed to cut down on walking.

* Double soabar was causing problems and darts should have been pre-soabarred. The machines were possibly going to be moved to the front of the line.

* Consideration was being given to introducing more underpressing on open seam styles instead of safety stitching seams. This would require additional training.

* The operators felt that they were losing time on the cadets (data collectors). They recommended that the company replace the old tickets and clean the units to prevent malfunctions.

* The operators also recommended that the rate for the ticketing operation be reexamined.

* There were quality problems with the side pocket patterns. They had two different size pocket openings. The operators asked management to examine the patterns.

* Poor quality fabrics that were provided to Triple A were leading to defects, sewing problems, and reduced earnings.

* Red Line operators were upset with other operators from the plant using machines on the Red Line without asking and also taking thread from unattended Red Line machines. It appeared that operators in the progressive bundle lines did not understand that idleness in a module can be very temporary.

* Management requested that operators keep the work stations clean by keeping thread on the stands and not in the bins.

JUNE

Sales/production was still running 25% higher than projected. With the high production it was difficult to condense the line by combining operations and cross training. Only a few operations were combined or sequenced:

* Press Tops and Press Legs became Press Tops & Legs.

* Turning and Tickets became Turn & Ticket.

* Set & Tack Loops and Zipper Stop & Fly and Outlet Tack became Set & Tack Loops / Zipper Stop / Fly & Outlet Tack.

* Final Exam and Pinking became Pink & Final Exam.

Triple A was continuing to experiment with incentive pay plans. They were as follows:

* A predetermined amount per hour would be added to the piece rate earnings and the percent incentives would be compared against the training averages. Operators would be paid whichever was highest. Make up pay would be the difference between what was earned versus what was guaranteed.

* For each additional operation the operator learns, the operator would receive a certain percent increase in pay.

JULY & AUGUST

During the remainder of the summer sales and production continued to run 25% above predictions. As a result several things had happened:

* Additional operators had come into the Red Line.

* The layout had not been finalized.

* The introduction of a group incentive was on hold for consideration in September.

* Some operations were being performed outside of the Red Line.

* The incentive system was revised to get the operators off the guaranteed training rates and back onto individual incentives.

It appeared at this time that the operators were not pleased with the revisions to the incentive system and the loss of guarantee. It also appeard that the operators were not interested in what was happening elsewhere in the module and preferred to stay on their primary job even if they or someone else might run out of work if they did not move. The lack of a group incentive had stalled any additional progress that might have been made.

SEPTEMBER

The Red Line was still not in its final format, and had just added three new members to the line. The first was to replace an employee who resigned and the other two were added because it was determined that sales were going to stay higher than originally predicted for this line.

Discussions continued on reducing make up pay in the group, retraining costs, group incentives, and work transport.

A new incentive plan was suggested by the research team.

A recommendation was made that bundle trucks be looked at to replace work benches that were currently in use in the module. It was felt that these trucks would work more effectively in the module with its combination of sitting and standing jobs. Because the trucks would utilize less work space, the unit would be able to move closer together.

Neither of the recommendations were implemented, though they were being considered for a new plant.

OCTOBER

Triple A had two major problems that we addressed. The first was layout and the second was compensation.

Our opinion was that it was time to finalize the layout of the operations as the production volume and each operator's skills level within the module had been determined. It was our feeling that changing the layout in a recommended manner would eliminate unnecessary benches and empty space so that work could be transported more easily. Operators in the group would be able to see each other and be able to anticipate when they would need to move from their operation to another to keep the unit moving. This would also help increase the teamwork within the module.

As regards compensation, it was felt that, since the training guarantee had been lifted and the operators had gone back to individual incentives with bonuses for job switching, some of the teamwork had been lost. (We have since talked extensively about group incentives.) It should be noted that James Alperin and John Vohls from Triple A attended the Bobbin Show and participated in the discussions on compensation to gain additional knowledge on other systems being used in the industry.

NOVEMBER AND DECEMBER

It seemed that the production level in the other lines had diminished somewhat and there was a growing morale problem in the plant. The morale of the workers was being adversely affected as they felt that too much attention was being paid to the module operators. Reevaluation of costs, goals, and long range strategies of the company were in order.

The module was modified. The front end parts operations were combined with the Yellow Line to take advantage of volume and the corresponding cost reduction. The first stitch and other assembly operations were kept in the Red Line. Previously developed incentive systems were dropped and the line returned to standard engineered incentives.

JANUARY

At this time most vestiges of the original modularized Red Line no longer existed at Triple A. What once was a full production line was now a small battery of operations. The front end operations for garments processed through this battery are performed on the adjacent Yellow Line. Then, these garments are pressed in a common pressing area. This battery initially had four operators, but was increased to eight operators to meet an increasing demand for the particular styles of trousers that are run on the Red Line.

The volume for this battery of operations is such that the operators work a regular shift between only two operations which allows them to have enough work to last a full day every day. The operators are paid the standard piece rates for the operations.

The causes of this current situation can be traced back to the original reason for experimenting with modular manufacturing. Originally, work for the Red Line was dropping in volume so Triple A management looked to modular as a way to keep a shrinking workforce busy. Typically, prior to the switch, operators worked only four hours out of eight. This dropped their efficiencies and increased Triple A's overhead. Once the module was in place, the 14 operators worked full days, were crosstrained for greater flexibility and could handle shorter runs and more styles. But since no acceptable group incentive could be installed, costs in the Red Line ran 25-30% higher (40% initially) than was acceptable.

Several factors spelled doom for the modular line:

* Earnings potentials among the operations varied widely thereby causing cooperation problems.

* Morale throughout the factory dropped (Yellow and Green Lines often worked only half days while Red Line worked full days.

* Volume demand for Red Line items increased compared to drops for the Yellow Line, thus creating further disparity.

The Triple A management decided to solve several problems by making the following changes:

* Front end Red Line operators were moved to the Green and Yellow Lines. In some cases they were retrained for different operations.

* Front end and pressing operations needed on garments for the Red Line would be performed on the Yellow Line. The specialized operations of the back end would be performed on a battery of machines (16 operations) in the Red Line area. The operators in this battery have enough consistency of work to stay on one or two operations each day.

* The modular concept of processing pieces instead of bundles has been retained in the 16-operation battery, thereby lowering the work in process. This group has continued without a bundle service person, thus obtaining a direct advantage from the modular experience.

These changes have provided higher consistency of work for the Yellow Line and, therefore, this line is out of work much less. Volume demands have since increased the number of full time operators in the battery to eight. These operators have been drawn from the original modular group and work at a better efficiency.

A welt cut-in back pocket group was set up in August to service all three lines as a result of the modular experience, keeping more people working also.

Overall factory morale has improved since the final changes were made in July/August.

Triple A management looks to the changes they have made as a positive result of their experiment with Modular Manufacturing. Said John Vohls, "The timing [of publicity and available information on Modular Manufacturing] enabled us to get our feet wet and taught us some valuable lessons [in improving our business]".

Joe Scarpo said, "If we had not done [the modular experiment] the Red Line would have ceased to exist".

Mr. Vohls indicated that if a new, stylized line were required in the future, they may attempt to utilize Modular Manufacturing once again.

B.2.3. **Statistical Summary.**

B.2.3.1. Make Up vs Sew Repair.

From Charts 1-5, which were generated by company statistics, one would conclude that modular cross-training causes increased repairs and make-up pay. In truth, however, this is an incorrect conclusion.

Repairs records from detailed quality control reports and production shifts taken from the real time data collection system proved something else. Operators with previous quality problems continued as before and did not seem to improve. Operators who took pride in their work continued to do so even when being cross-trained. When compared, repairs are not shown to be any higher in the module than they are in the other lines.

It appears that there are other, more significant factors, that impact make-up pay at Triple A than repairs:

* We feel that out-of-work waiting is an unmeasured but significant factor.
* Repairs and training seem to have a more direct relationship with each other on the Red Line, especially since out-of-work is not a problem.
* Make-up pay is out of control on the Red Line. Part of the problem may be related more to method of pay than actual production per operator.

B.2.3.2. Cost Summary

Item	Cost	Saving
Work in Process		Reduced 67%
Throughput Time		Was 10-15 days, now 3-5 days.
Clerical	None. Computer system can handle the calculations.	
Indirect Labor		Eliminated supervisor. Eliminated bundle handler.
Square Footage		Reduced 33%
Planning	Est. 300 hours	
Seminar	$6,000	
Make-Up Cost	30% above normal	

B.2.4. **Group Dynamics.** It was our opinion from observation and interviewing that the true modular project was not going to survive. Management held meetings with the employees, but the employees felt that nothing of significance happened at those meetings and relied more on information gleaned from their supervisor.

Part of the problem was that no one could commit to the configuration for a long period of time because the marketing information was inconclusive. It was this sales dilemma that finally ended up reshaping the size of the module as well as one of the other lines located adjacent to the module.

Initially the operators participated as a unit, and leaders were chosen by the group to handle specific problems. Selection was based on the problem and the perceived expertise of each person. As the operators were being paid a modified guarantee, they did not feel any adverse economic impact from their additional involvement in activities that affected the module.

Just before vacation time, morale took a downward turn when management suspended the midpoint guarantees and reverted to individual incentive as the only method of compensation. The operators stopped thinking in terms of the module unit and reverted to trying to remain at their primary operation on a full time basis. No one wanted to voluntarily watch the level of soabar work, sequence of cuts, thread needs, or perform the short cycle jobs such as pin ticketing that were needed to complete the trousers. The team had been broken down to individuals again and the operators were noticeably upset about the module.

After vacation, management was still experimenting with the unit and was also looking hard at productivity requirements in two lines. The sales shifts had become permanent and while the Red Line (module) operators were working full weeks, other operators in the plant were not. As this continued over a period of time, the morale of the plant was adversely impacted. Resentment was directed at the Red Line as the other operators began to feel that they were unequal and weren't getting as much attention.

By reconfiguring the front end of the module, management solved several problems. The Yellow Line now had sufficient work and the plant morale problem was lifted. In addition, the Red Line assembly operations were kept together as a unit. The operators could stay at their primary jobs for most of the day and remain on individual incentives. The Red Line operators are now functioning in more of the traditional progressive bundle style with the operators less involved in self-direction than was originally anticipated.

During this exercise the operators have learned how to work with less work in process and have become more aware of other jobs through cross-training. These benefits were found to extend well beyond the Red Line and actually encompassed the entire plant. This could have been predicted by looking at the overall characteristics of the personnel in the plant. The tests that we conducted showed a strong homogeneous nature and a strong feeling of belonging. The team was not simply the Red Line, but the whole plant.

It was fairly obvious to us that group incentives are important if we wish to get the members of a team of employees to be jointly responsible for producing first quality goods together. There are many secondary functions that must be performed by the operators to keep the module operating. It appears that individual incentives alone seem to encourage performance that discourages the successful completion of these tasks on a voluntary basis.

B.2.4.1. Work-Needs Assessment Inventory. The Work-Needs Assessment Inventory (Appendix A) was administered to the employees of Triple A Manufacturing at the beginning of our study. The conclusions are those developed at the time of the test. As you will see, this test seems to be a good predictor of small group behavior for this firm and lends support to the theory that with the proper tools we can predict success or failure in choosing manufacturing processes. The commentary below is taken from the report when the test was administered. It should be compared against the history (section B.2.1.) when evaluating its effectiveness.

Test Scores

EMPLOYEE	ACHIEVEMENT	AFFILIATION	POWER
1	29	38	41
2	35	37	36
3	36	31	41
4	36	34	38
5	34	34	40
6	35	35	38
7	33	39	36
8	31	36	41
9	33	35	41
10	37	31	33
11	34	36	37
TOTAL	373	386	422

Organization Behavior Predictions:

The members of the group group have a strong tendency towards and a desire to be affiliated in a group. This can be an advantage if proper incentives are developed to reward achievement. If earnings are decreased, problems will occur such as: low motivation and morale which may cause poor quality; decreased productivity; lack of interest; bitterness; and, animosity toward management.

B.2.4.2. Supervisor Questionnaire FLEXIBLE MANUFACTURING: ARE YOU READY FOR IT? June 18, 1990

The management test, "Flexible Manufacturing: Are You Ready For It?" (Appendix B) was administered in June to the plant manager, supervisor, and human resource manager/administrator, all of whom are directly involved with the Red Line. The test showed that the front line managers were skeptics of flexible manufacturing while the human resource manager was supportive. Those attitudes carried on through the year and leads us to wonder if the management team to be used in a start up should not be pre-selected as well. This is an area we believe should be explored in future research efforts.

Supervisor Questionnaire Scoring

Statement	Supervisor 1	Supervisor 2	Supervisor 3
1.	4	3	4
2.	3	3	4
3.	3	3	3
4.	2	2	3
5.	4	3	4
6.	4	2	3
7.	1	2	2
8.	2	3	3
9.	4	4	4
10.	1	3	3
11.	3	1	4
12.	4	1	4
13.	3	3	2
14.	2	2	2
15.	3	3	4
16.	3	3	4
17.	2	3	4
18.	3	3	4
19.	3	3	3
20.	3	3	3
21.	3	3	4
22.	2	2	3
23.	3	3	3
24.	3	4	4
25.	2	1	3
TOTALS	70	66	84

C.1. **CONCLUSIONS**

We approached this project without any preconceived notions as to the worthiness of Modular Manufacturing. We wanted to see if it was just a fad or a new business strategy that could be added to a manufacturer's arsenal in the master plan to accommodate Quick Response.

After observing the two firms and studying the costs and benefits of them both, we feel that Modular Manufacturing is a viable management strategy. Some significant points we have discovered are as follows:

1. Modular Manufacturing requires total management commitment.

2. Modular Manufacturing significantly reduces work in process.

3. Modular Manufacturing improves the quality of the finished product because defects or sewing problems are spotted faster with reduced inventory between operations.

4. Operator earnings have the potential to increase as some of management's former tasks are taken over by the group which may then participate in gain sharing.

5. Marketing programs have an immediate impact on manufacturing. In both cases studied here the return on investment analysis for the conversion was bypassed in favor of the non-traditional payback which was derived from a marketing need. Analyses were completed later based on usual cost and value added data generated from operations but the need from marketing precluded the traditional payback analysis from these ventures.

6. The pressure on management and floor supervisors increases as work in process is reduced and more decisions have to be made more often during the day to avoid stoppages in work.

The role of the supervisor becomes more complex. Traditionally, in a progressive bundle system the supervisor is a bundle mover, record keeper, and only infrequently is called upon to handle a human relations problem. Because of the excessive levels of work in process there is no great pressure to make immediate decisions to compensate for lateness, absenteeism, training, or other productivity factors.

In a modular environment operators and indirects are a team. The team must be directed in its mission and must work as a unit. The module cannot afford to have personality conflicts, absenteeism, chronic lateness, or attitude problems. The supervisor must be taught how to recognize these and other problems within the module and how to successfully intercede and move the team in a positive direction.

The supervisor must be thoroughly familiar with the concepts of plant loading and balancing as lower work in process levels require faster response to avoid work stoppages. A thorough knowledge of garment construction also helps to solve minor problems that could keep the line from having to shut down.

Mechanical aspects of the module must also be watched. Minor adjustments must be able to be made by the supervisor without waiting for the mechanic. Firms must now be aware of the level of technology that is in place and what level can be absorbed by the operators and supervisors within the modules.

We are cautiously optimistic that new training programs for supervisors will address these issues. Once again, success or failure rests with management's understanding of the problems and it's unqualified support, not only for the initial training, but for the continuous learning that must be encouraged. All too often we see that management leads with a flourish, expects instant success, and then loses interest after a short time as its focus shifts to another area of the business.

In many firms the education need will be substantial as supervisors who have been promoted through the ranks, lack the outside academic training that is needed to grasp some of the concepts inherent in these programs.

7. The best module size appears to be 3-5 operators working together.

8. Complex garments can be produced in a modular environment utilizing multiple modules.

9. Group incentives appear to be important to operator acceptance of working in a module and achieving desired productivity goals. It is suggested that a split of 60% group/40% individual incentives will yield desirable effects.

10. We should show patience as we attempt to introduce a new strategy into the workplace that is counter to a philosophy of compensation and work effort that had been espoused for many years. Modular Manufacturing encourages self initiative and job enlargement in the workplace. Operators need to see that this increased responsibility and teamwork will be rewarded and will not decrease their earnings.

11. Once convinced that Modular Manufacturing is a strategy to keep the firm in business and to keep them working full work weeks, we feel that operators will sign onto the program with full commitment. We do not feel, however, that there needs to be a pat formula for what firms must do to go modular. We are convinced that flexibility by management is the surest path to success.

C.1.1. **Future Research Needs**

We have uncovered some results that we did not initially anticipate and which we believe should be investigated further.

We expected that quality problems would increase for the unit during the cross-training period in the initial phase of transitioning to a modular unit. In analyzing the performance of the operators, their earnings, quality audit results, and time audits we discovered that operators who were quality conscious in the progressive bundle system carried that over to the module. It did not matter how many operations they tried to learn in the module. If this condition were to hold for other firms, then we might be able to save some significant costs by prescreening operators through a written test and performance data, if available, that would measure attitudes and the likelihood of successful participation in a module.

We feel that the question of the interrelationship of quality, make-up cost, and operator screening is significant enough to suggest that future research efforts be initiated in this area.

It is our opinion that preselection of employees may be an area requiring investigation. The intent would be to predict success and avoid the high costs of turnover.

REFERENCES

AAMA, 1989 Report of the Technical Advisory Committee, Making The Revolution Work: How to Implement Flexible Apparel Manufacturing Through People.

Baker, H. Kent, "The Hows and Whys of Team Building", Personnel Journal, June 1979.

Bennett, Billy, "Steps To Flexible Operators", Bobbin, April 1989.

Frohman, Mark, "PM* Participative Management: The Missing Ingredients", Industry Week, December 4, 1989.

Johnson, Cythis Reedy, "An Outline for Team Building", Training, January 1986.

King, Pamela, "What Makes Teamwork Work?", Psychology Today, December 1989.

Littlejohn, Robert F., "Team Management: A How-To Approach to Improved Productivity, Higher Morale, and Longer Lasting Job Satisfaction", Management Review, January 1982.

Marninghan, J. Keith, "Group Decision Making: What Strategies Should You Use?", Management Review, February 1981.

McClelland, D.C., The Achieving Society, New York: Irving, 1979.

Sadtry, Ravi, Teamwork On An Assembly Line: An Analysis Through Case Studies and Simulation Models of Actual Facilities, Rensselaer Polytechnic Institute, December 1989.

FIGURE 1: Allison Jacket

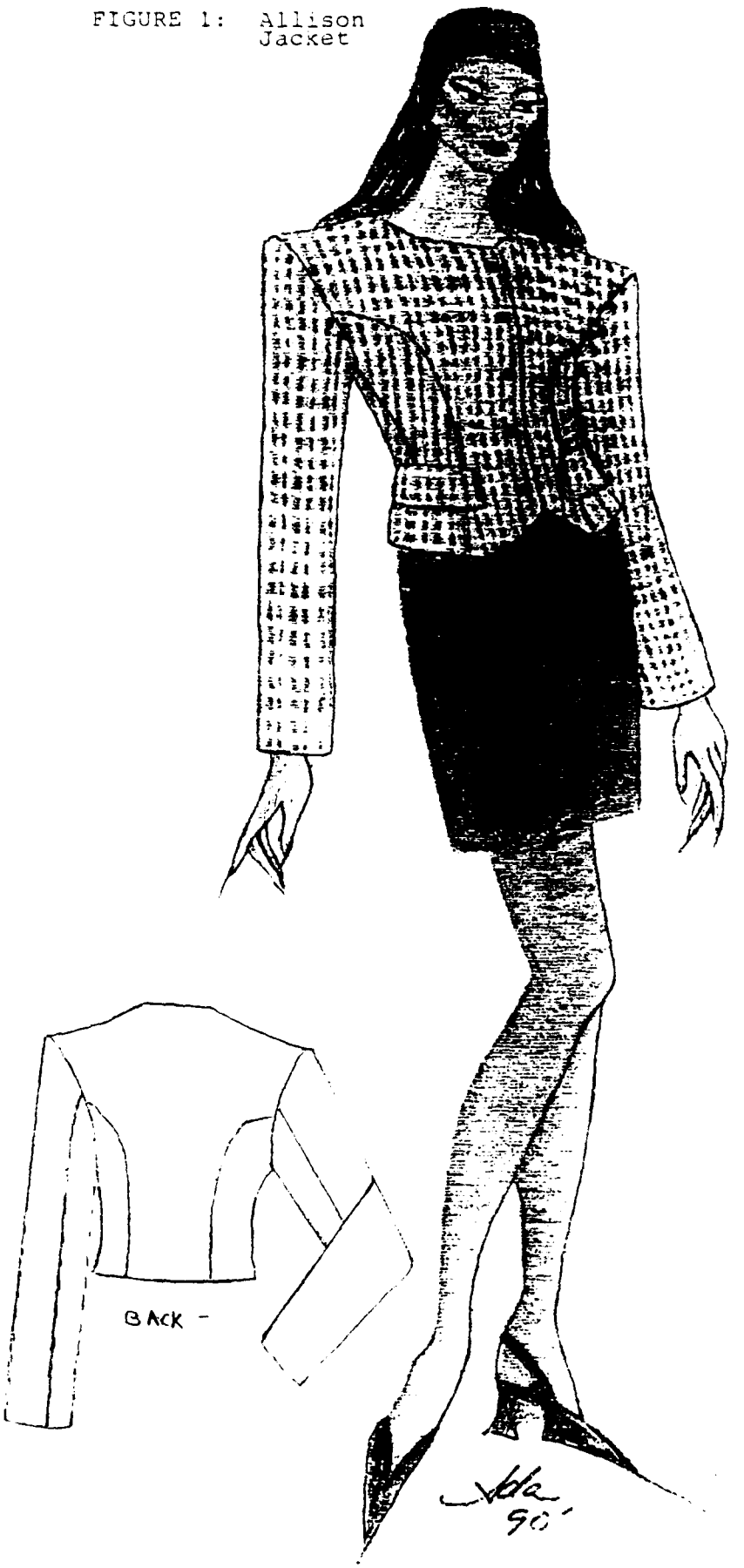


FIGURE 2: Allison Jacket

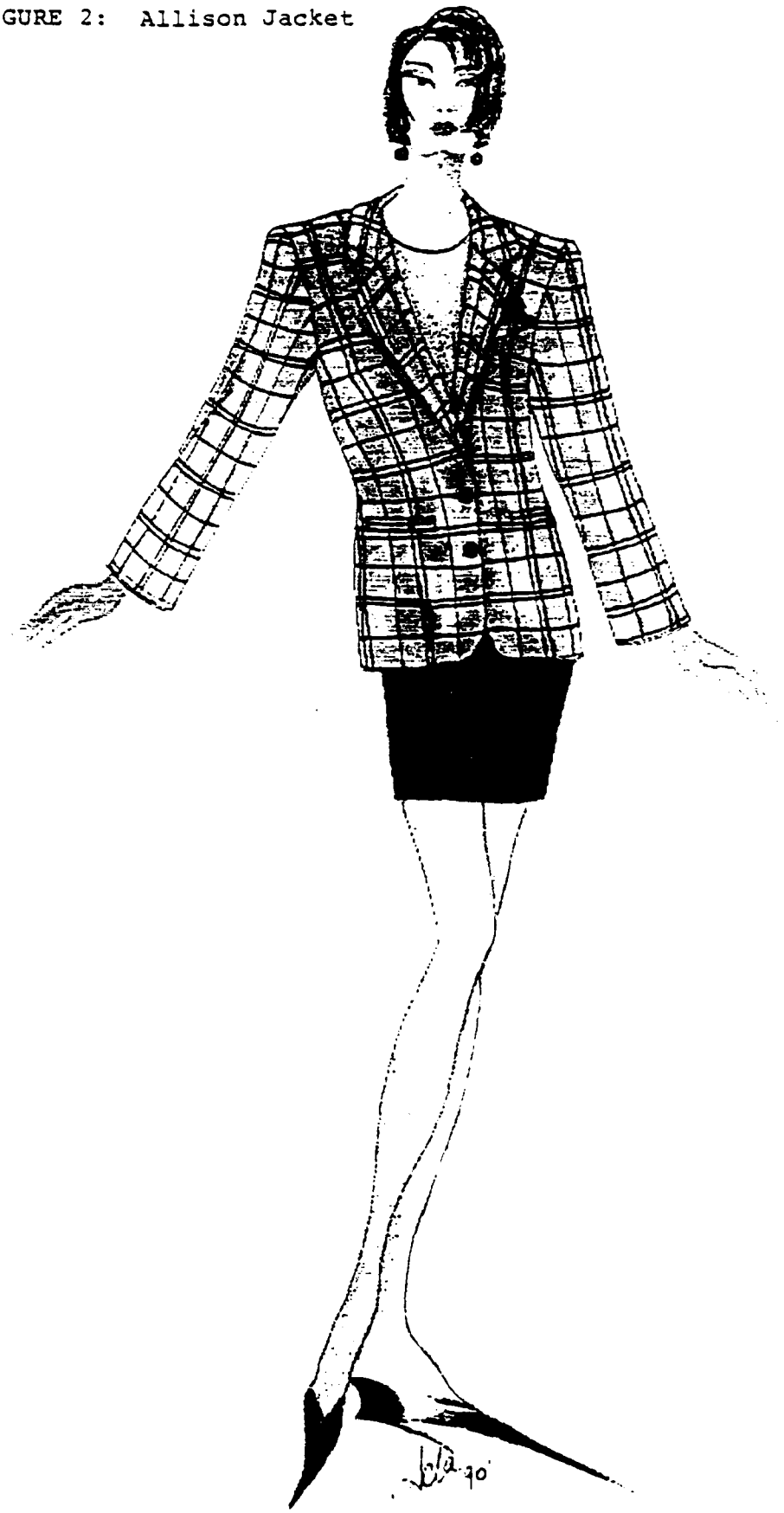
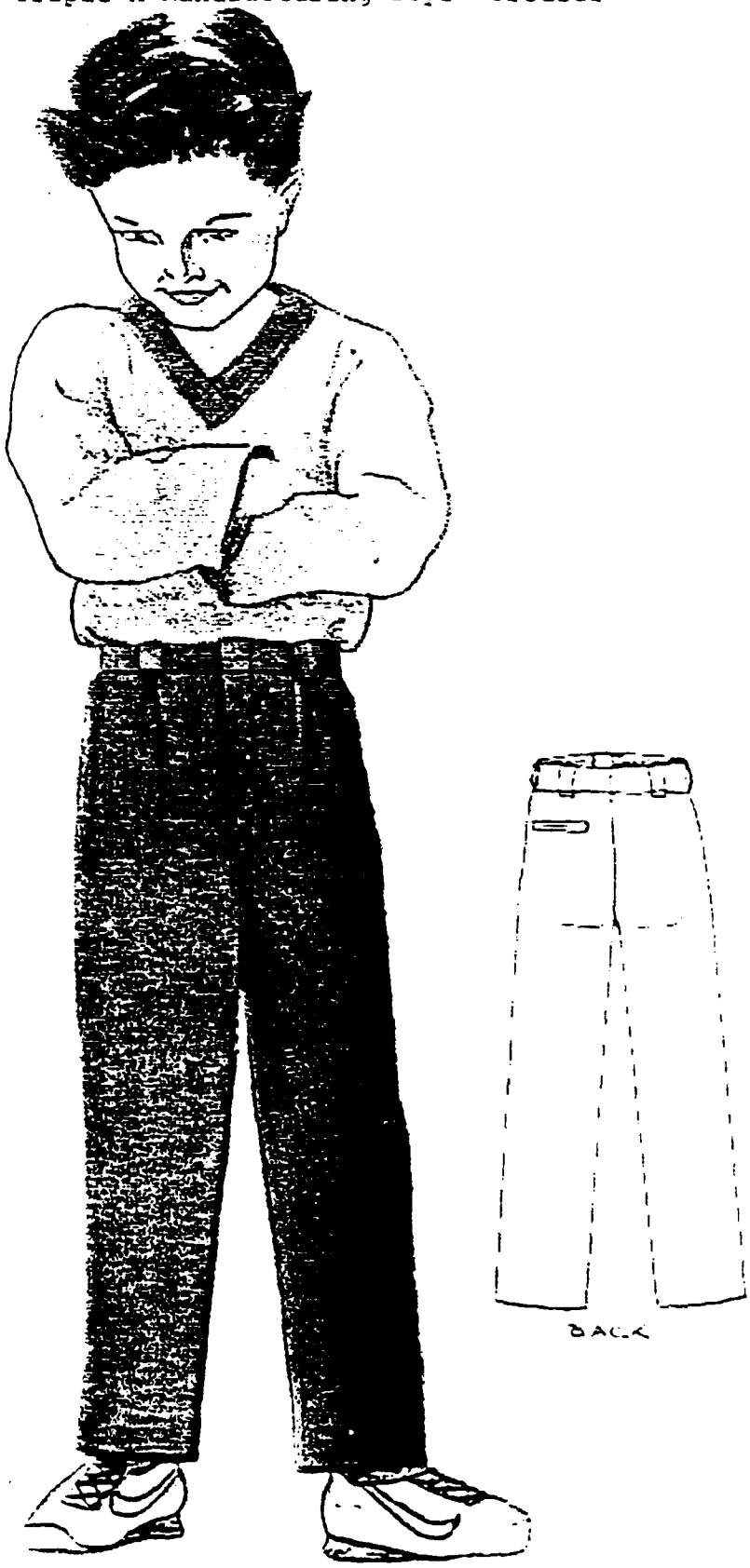
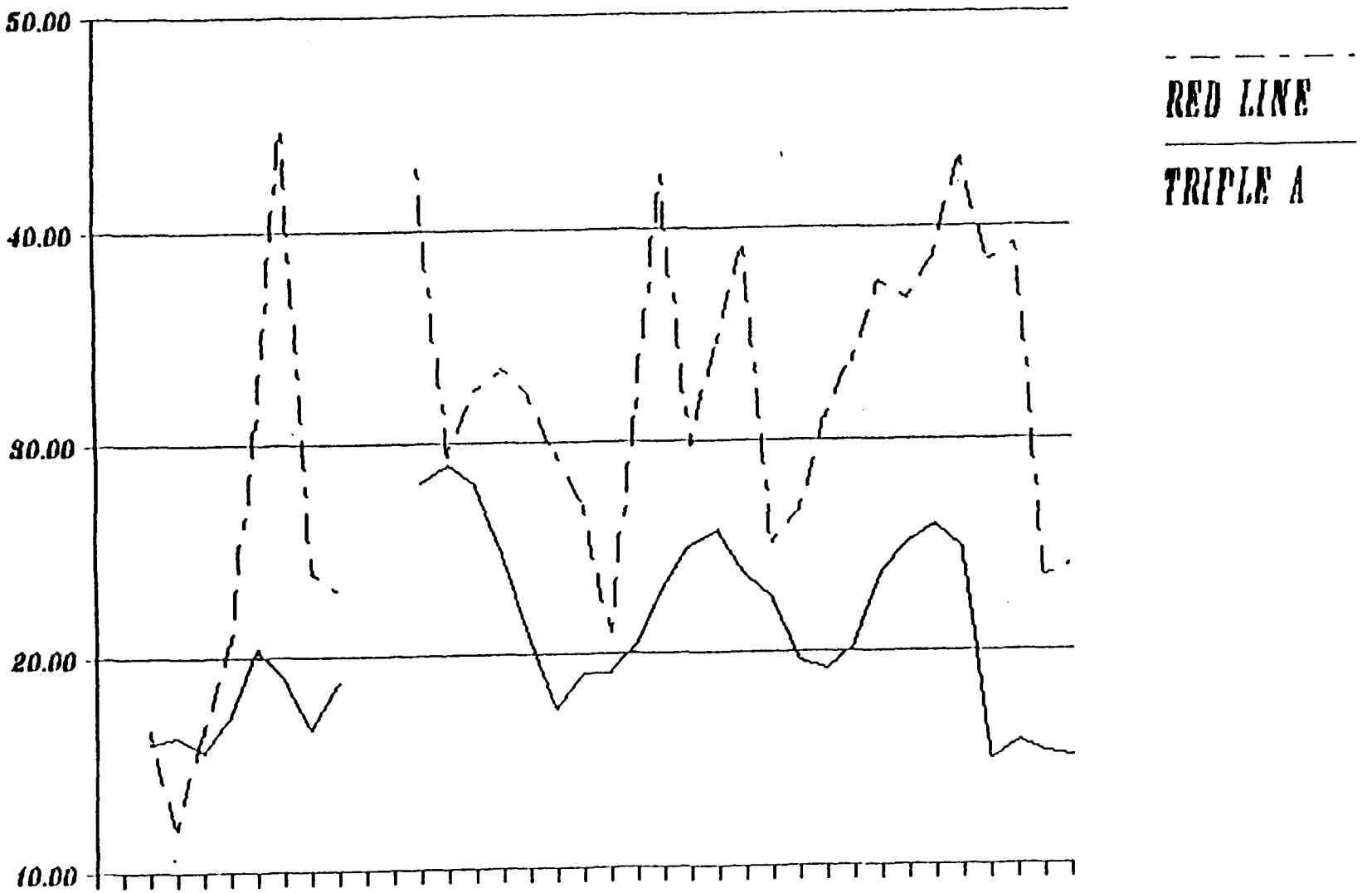


FIGURE 3: Triple A Manufacturing Boys' Trouser



MAKE UP PAY PERCENTAGE

RED LINE VS TRIPLE A



1990

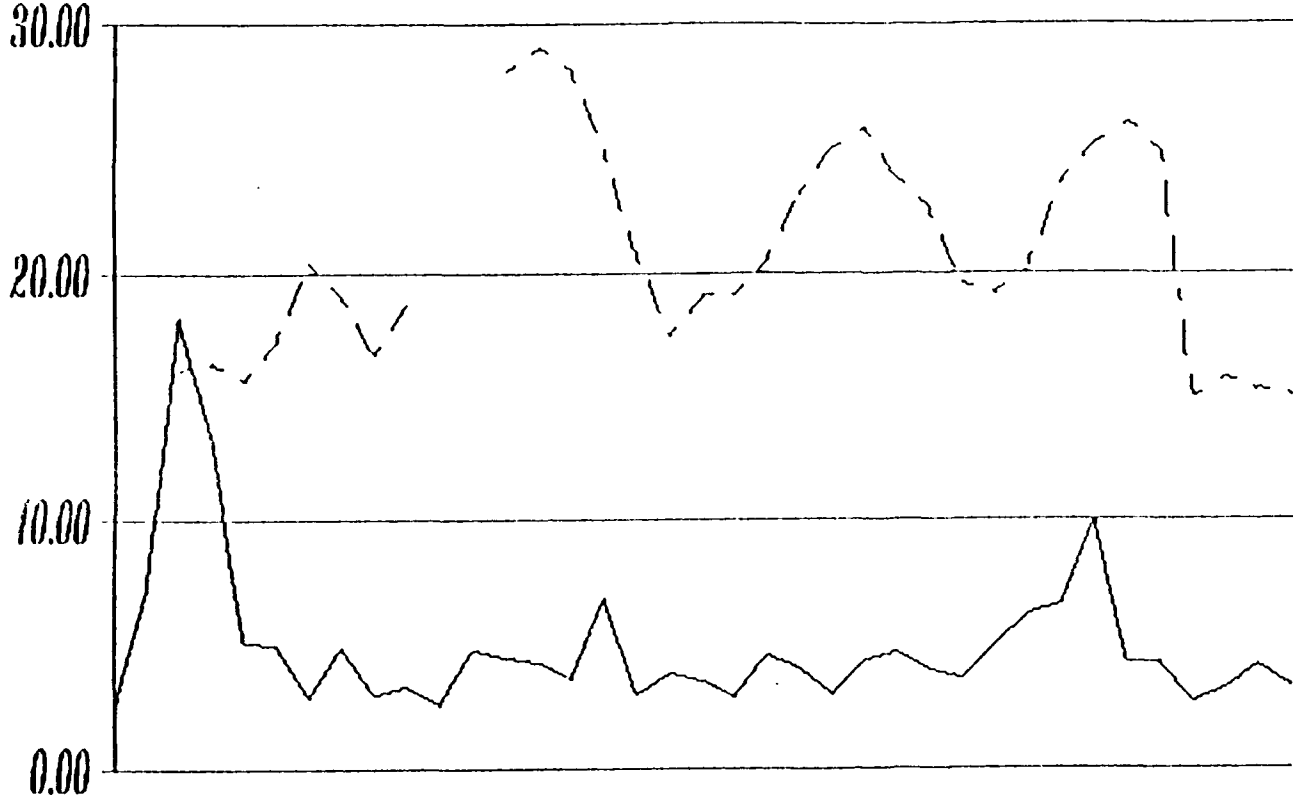
JAN TO NOV. 16 BY WEEK

CHART 1

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

TRIPLE A

MAKE UP VS. SEW REPAIR



MAKE UP %

% REPAIRS

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

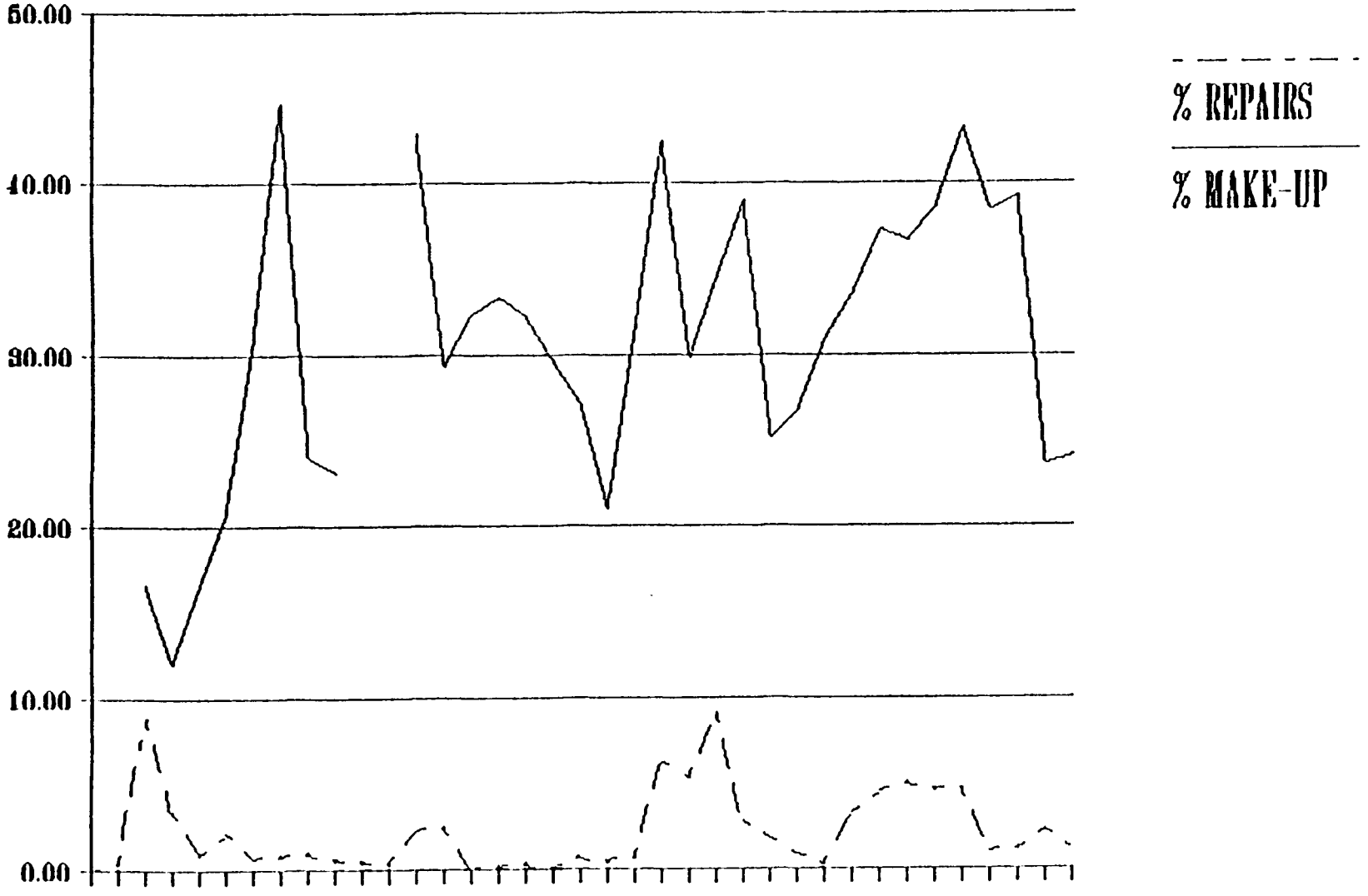
1990

JAN TO NOV 16 BY WEEK

CHART 2

MAKE UP VS. SEW REPAIRS

RED LINE



1990

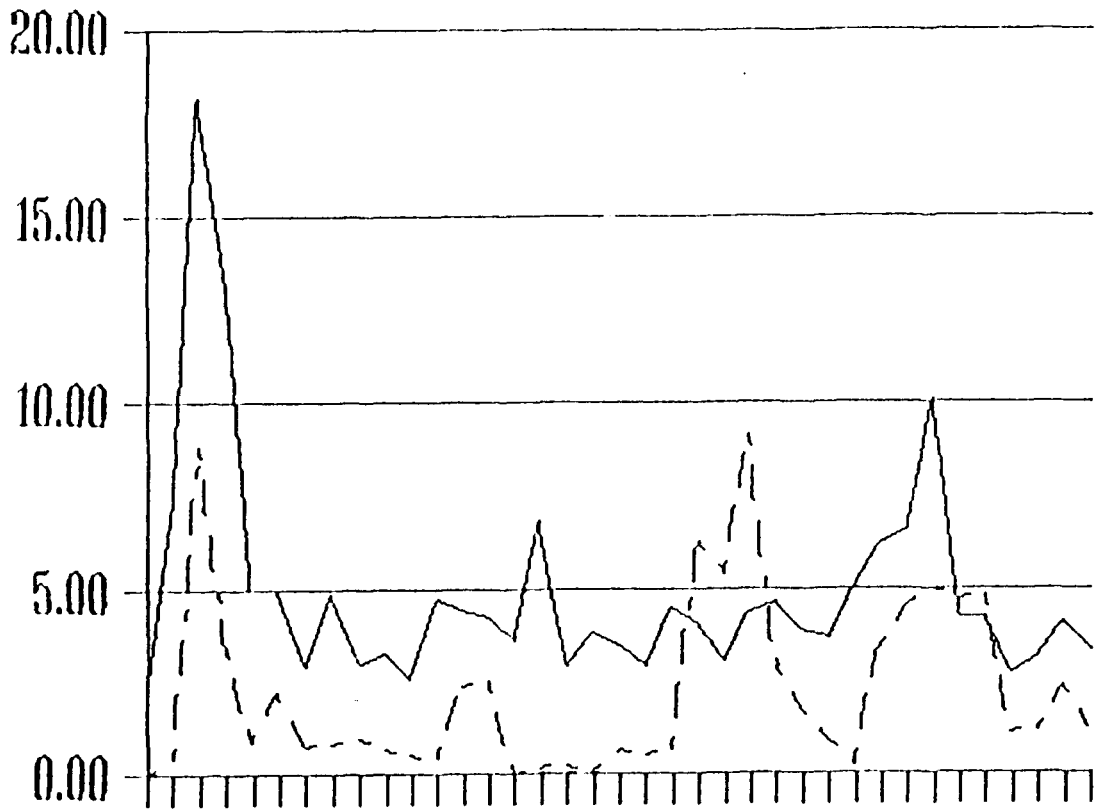
JAN TO NOV. 16 BY WEEK

CHART 3

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

MAIN LINE VS. TRIPLE A

COMPARE SEWING REPAIRS



RED LINE

TRIPLE A

IN PERCENT

1990

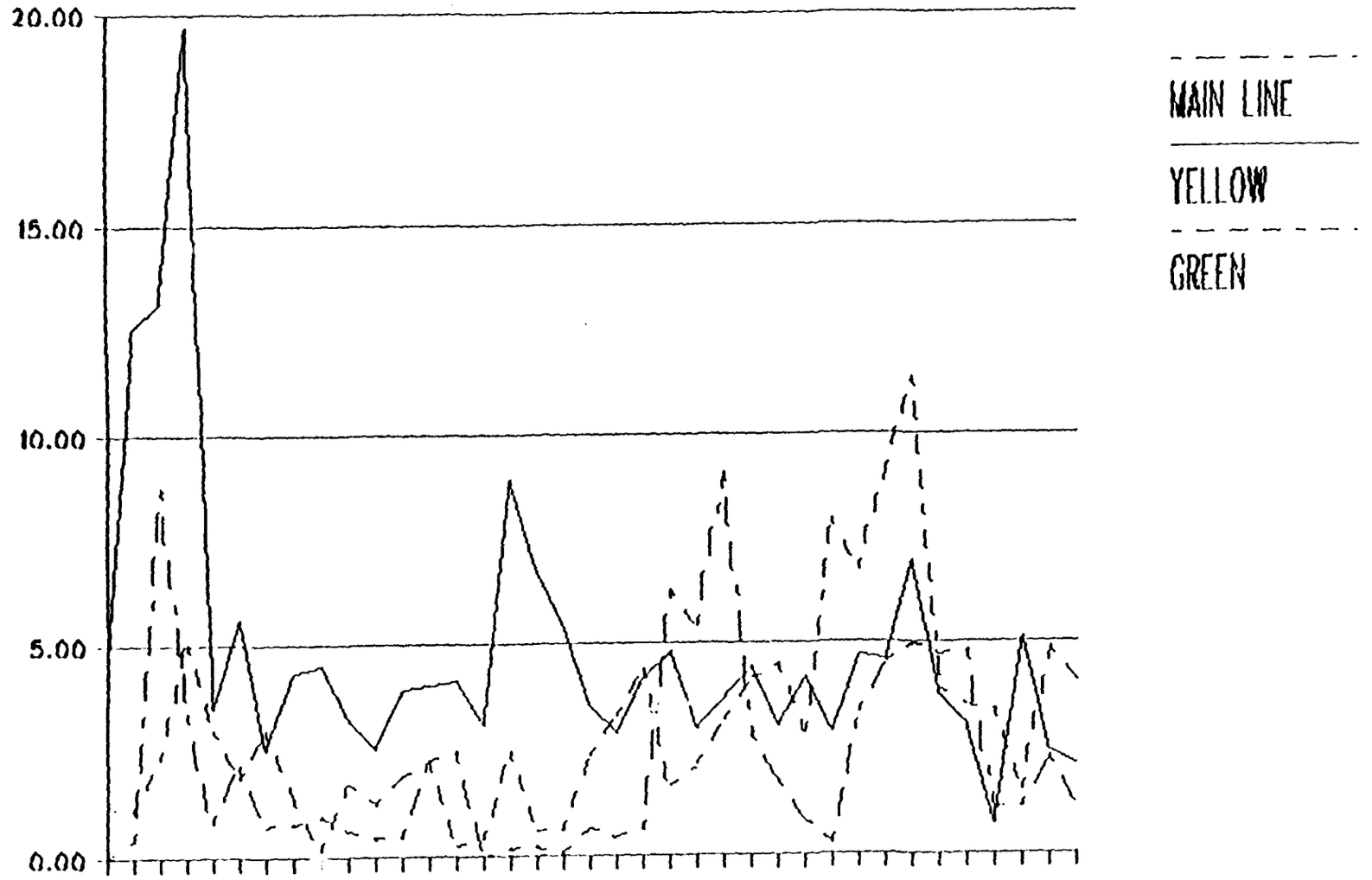
JAN TO NOV. 16 BY WEEK

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

CHART 4

RED VS. YELLOW VS. GREEN

PERCENTAGE OF REPAIRS



1990

JAN TO NOV. 16 BY WEEK

CHART 5

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

APPENDIX A

WORK-NEEDS ASSESSMENT INVENTORY

Instructions: Each of the following numbered items consists of three statements. For each separate item, rank each of the three statements according to how descriptive it is of *your own* feelings or opinions about work or of your behavior in a work environment. In the blanks provided to the right of the statements, write *1* for the statement that is *most* descriptive, *2* for the statement that is *next most descriptive*, and *3* for the statement that is *least descriptive.*

Some of the statements imply that you are presently a supervisor; if you are not a supervisor, evaluate these statements according to the way in which you believe you would feel, think, or behave if you were.

	Rank
1. a. When solving a problem, I like to work by myself and be solely responsible for the solution.	_____
b. When solving a problem, I like to work as part of a team and find a team solution.	_____
c. When solving a problem, I like to work as part of a team, but only if I am in charge.	_____
2. a. Managers should set challenging goals for their subordinates.	_____
b. Goals should be set through mutual agreement of team members.	_____
c. It is important to set goals that are within the average individual's capacity to achieve.	_____
3. a. My co-workers would describe me as a good listener.	_____
b. People describe me as fluent.	_____
c. I tend to focus my conversations at work on job-related matters.	_____
4. a. I enjoy discussions that are directed toward problem solving.	_____
b. I sometimes take an opposing point of view in a discussion just as a matter of interest.	_____
c. I enjoy discussions that enable me to know my fellow workers better.	_____

5. a. I enjoy being perceived as a team member. _____

   b. Belonging to a specific team is not a priority with me. _____

   c. I enjoy my individuality; being seen as a team member does not interest me. _____

6. a. I like to have feedback about how well I have worked with others as a team member. _____

   b. I like to have specific feedback about how well I have done a job. _____

   c. I am the best judge of how well I have done a job; raises and/or promotions are the feedback that is important to me. _____

7. a. The most important aspect of performance analysis is the setting of future goals for an employee. _____

   b. The most important aspect of performance analysis is the planning of an employee's future development. _____

   c. The purpose of performance analysis is to isolate what an employee has done correctly and what mistakes he or she has made. _____

8. a. Conflict is a tool that can be used to arrive at the best possible solution to a problem. _____

   b. Conflict can be very healthy; it keeps people on their toes. _____

   c. Conflict should be controlled; teams whose members argue among themselves are seldom productive. _____

9. a. A factor of concern with any problem solution is its acceptability to the team that must implement it. _____

   b. If I am convinced that a problem solution will work, I expect it to be implemented and I accept responsibility for the consequences. _____

   c. If I find a problem solution that works, I want to implement it; prolonging discussion about it with team members is usually a waste of time. _____

10. a. If one of my subordinates does something incorrectly, I show him or her how to correct it. _____

    b. If one of my subordinates does something incorrectly, I discuss the situation with him or her, and we agree to correct it. _____

    c. If one of my subordinates does something incorrectly, I tell him or her to correct it. _____

11. a. People should use mistakes as learning tools and thus improve themselves. _____

    b. I make mistakes, but as long as I am right most of the time, I deserve my job. _____

    c. I do not like being wrong; I do not make the same mistake twice. _____

12. a. With hard work and the support of the right management, an individual can overcome most problems. _____

    b. Hard work can overcome most problems. _____

    c. A strong commitment can overcome most problems. _____

13. a. I focus more on my personal relationships with my peers and my supervisor than I do on my relationships with my subordinates. _____

    b. I spend time and effort developing and improving my personal relationships at work. _____

    c. I develop personal relationships at work only when they help me to complete my work tasks. _____

14. a. "Do not step on people on the way up; you may meet them on the way down." _____

    b. "Nothing succeeds like success." _____

    c. "Nobody remembers the name of the person who came in second in a race." _____

15. a. If I am right, I will win in the long run. _____

    b. If I am strong in my convictions, I will win in the long run. _____

    c. I try to be patient with people; doing so pays off in the long run. _____

16. a. Workers produce satisfactorily when their supervisors work alongside them. _____

    b. Workers' productivity increases when they have input regarding their job tasks. _____

    c. Workers must be challenged to reach new heights of excellence. _____

17. a. I enjoy convincing my fellow team members to do things my way. _____

    b. As long as a decision is right, whether it was an individual decision or a team decision is not important. _____

    c. For any decision to become final, all members of the team that will implement it should find it acceptable. _____

18. a. I work well when I have a personal relationship with my supervisor. _____

    b. I work well in situations in which I am my own boss. _____

    c. I work well when I have deadlines to meet. _____

WORK-NEEDS ASSESSMENT SCORING SHEET

Instructions: Transfer your rankings from the inventory to this sheet. Then add the numbers in each vertical column and write the total in the blank provided. The column with the lowest total represents your first-priority need; the column with the next-lower total represents your second-priority need; and the column with the highest total represents your third-priority need.

Achievement Need	Affiliation Need	Power Need
1a _____	1b _____	1c _____
2c _____	2b _____	2a _____
3c _____	3a _____	3b _____
4a _____	4c _____	4b _____
5b _____	5a _____	5c _____
6b _____	6a _____	6c _____
7a _____	7b _____	7c _____
8a _____	8c _____	8b _____
9c _____	9a _____	9b _____
10a _____	10b _____	10c _____
11b _____	11a _____	11c _____
12b _____	12c _____	12a _____
13c _____	13b _____	13a _____
14b _____	14a _____	14c _____
15a _____	15c _____	15b _____
16a _____	16b _____	16c _____
17b _____	17c _____	17a _____
18c _____	18a _____	18b _____
Total _____	*Total* _____	*Total* _____

WORK-NEEDS ASSESSMENT THEORY SHEET

The McClelland Model

McClelland (1976), the leading researcher on self-concept, has studied human behavior for many years and has theorized that people are motivated by three basic needs: *achievement*, *affiliation*, and *power*. He has further asserted that although all of us possess all three needs, we possess them in varying degrees; one person's highest-priority need may be achievement, whereas another person's may be affiliation or power. The following paragraphs present a brief description of each need and the ways in which a high degree of each translates into behavior in an organizational setting.

Achievement

People with a high need for achievement enjoy challenging work, but they also want to ensure that they will succeed; tasks that present so great a risk that success is improbable do not interest or motivate them. Consequently, they tend to set conservative goals.

Achievers plan ahead to avoid any serious problems in their undertakings, but the planning function itself is not a source of motivation for them. They enjoy tasks for which they are personally responsible for the outcomes and with which they can be closely associated with the resulting success. They are quite concerned with meeting appropriate deadlines and experience great anxiety about any project until it has been completed successfully. In addition, they require frequent reinforcement consisting of "hard" data such as sales figures, standards, and so forth.

Affiliation

People with a high need for affiliation direct their energies toward the establishment and maintenance of effective working relationships with others. It is the need for affiliation that prompts people to examine the "human" side of decisions that are made within organizations. When this need supersedes that for achievement or power, the concern for receiving approval from and being liked by peers, supervisors, and subordinates becomes a critical factor in decision making and implementation. Whereas achievers focus on deadlines and the objective aspects of decisions, people whose highest-priority need is affiliation focus on the interrelationships that exist among those who are to be affected by the implementation of decisions. As group members, they try to maintain harmony and mutual respect among members while the group undertakes its function or objective.

Adapted from D.C. McClelland, *The Achieving Society*, Irvington, 1976. Used with the permission of the publisher.

Power

"Power" in terms of McClelland's model can be seen as the ability to overcome resistance in achieving an objective or goal (Pfeffer, 1981). People with a high need for power are usually quite fluent; because they enjoy arguing and confronting conflict, speaking skills are important to them. In an organizational setting, they tend to prefer autocratic decision making ("I make the decision, you implement it"), and they tend to see situations as win/lose ("I win, you lose").

Those whose highest-priority need is power are frequently political realists who evaluate situations in light of their political implications and determine a course of action on the basis of the outcome of their evaluations. When combined with a low need for affiliation, a high need for power may lead an individual to consider people as means to an end, and the value of establishing and maintaining satisfactory relationships in the organization may be lost.

REFERENCES

McClelland, D.C. *The achieving society.* New York: Irvington, 1976.

Pfeffer, J. *Power in organizations.* Marshfield, MA: Pitman, 1981.

FLEXIBLE MANUFACTURING ARE YOU READY FOR IT?

BY RONALD TREGO, PH.

APPENDIX B: SUPERVISOR QUESTIONNAIRE

Many apparel companies are currently implementing flexible manufacturing (FM) strategies, which emphasize multiproduct flexibility and fast market responsiveness. Implementing these changes has not only created significant technical challenges, but also challenged basic management philosophy. This dynamic relationship between FM and management philosophy has made this issue one of the most challenging facing the apparel industry today.

The following 25-item survey is specifically designed to measure the dimensions of your management philosophy that are the most and least compatible with FM. The results will provide a simple, yet useful means of comparing your management style with the basic principles of FM.

If this analysis reveals that your management philosophy is compatible with FM, then you can proceed with its implementation with a high degree of confidence that the results will be successful. If, however, the analysis concludes that your management philosophy is not compatible with FM, then you will want to deal with this issue before implementation.

MANAGEMENT PHILOSOPHY SURVEY

INSTRUCTIONS: Read each statement carefully. You will agree with some statements and disagree with others. To help express your opinions, you are offered four possible responses ranging from "Strongly Agree" to "Strongly Disagree." Choose the one that most closely reflects your opinion and mark (X) the corresponding box.

Work quickly. If you cannot decide definitely about a statement, mark the answer you feel is most like your opinion. Be sure to answer every statement.

PART I: Indicate whether you agree or disagree with the following statements. Check one box for each statement.

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Praising employees for good work only leads to demands for more money and benefits.	☐	☐	☐	☐
2. The potential to be creative is widely, not narrowly, distributed among employees.	☐	☐	☐	☐
3. One of the best motivators is to periodically remind employees that their jobs depend on their productivity.	☐	☐	☐	☐
4. The only type of recognition that means anything to most employees is more money.	☐	☐	☐	☐
5. A group of employees can usually find a better solution to a problem than one employee.	☐	☐	☐	☐

continued

COMPARISON OF COST AND PRODUCTION BETWEEN A TRADITIONAL BUNDLE SYSTEM AND MODULAR MANUFACTURING

BY RONALD TREGO, PH.D.

ROUND PEGS IN SQUARE HOLES

Management philosophy is a composite of attitudes, values, beliefs and experiences of the management group. It shapes and reflects management's reaction to change, their leadership style and supervisor/subordinate relationships.

Flexible manufacturing (FM) will require managers at all levels to critically evaluate their thinking concerning such issues as individual incentives, employee participation, cross-training, modular work units and piece-rate incentive systems. For example, if management believes that the average worker is inherently lazy, has little ambition and dislikes work, there will be many problems associated with the implementation of FM.

If the opposite attitude exists, FM will be more compatible with management's assumptions about the qualities, capabilities and motivation of employees. Similarly, leadership style is a reflection of

MANAGEMENT PHILOSOPHY SURVEY

continued

	Strongly Agree	Agree	Disagree	Strongly Disagree
6. Group incentives and straight hourly pay can be very effective at motivating individual productivity.	☐	☐	☐	☐
7. It is human nature to resent change. Most employees, if given a choice, prefer security over change.	☐	☐	☐	☐
8. Employees, not technology, are primarily responsible for production and quality levels.	☐	☐	☐	☐
9. Supervision would lose respect if they asked their employees for suggestions.	☐	☐	☐	☐
10. Most managers fail because they lack the technical "know how" for the job.	☐	☐	☐	☐
11. The nature of a supervisor's job makes it necessary for him to be unpopular with his employees.	☐	☐	☐	☐
12. Asking employees for their suggestions and opinions encourages unfounded griping and complaining.	☐	☐	☐	☐
13. Wage payment plans should not be based solely on worker output.	☐	☐	☐	☐
14. High wages and job security are the two things that are most important to employees.	☐	☐	☐	☐
15. Mistakes should not be tolerated. If employees are sufficiently punished, they will soon stop making mistakes.	☐	☐	☐	☐

PART II. Indicate whether you agree or disagree with the following statements. Check one box for each statement.

Most Employees:	Strongly Agree	Agree	Disagree	Strongly Disagree
16. Will work harder if they have more work ahead of them than they can possibly do.	☐	☐	☐	☐

continued

management philosophy. For a democratically, employee-centered manager, accepting FM might require little more than formalizing an existent program. In the final analysis, if management desires to maximize its return on investment in FM, it might have to redesign its own jobs, adopt new policies and make other changes to make the entire organization more compatible with FM.

Autocratic managers will find it extremely difficult, if not impossible, to adapt to FM concepts and strategies. The management philosophy of these managers not only resents change, but also contradicts the fundamental premise of FM. A management philosophy that reflects a 1940 mentality will not be effective with today's employees and manufacturing strategies.

In conclusion, FM strategies installed without first evaluating the management philosophy are almost certain to fail — because if management style is not compatible with FM, implementation is like trying to force a round peg in a square hole. ■

Ronald Trego, Ph.D. is a consultant psychologist located in Dallas, TX.

MANAGEMENT PHILOSOPHY SURVEY *continued*

	Strongly Agree	Agree	Disagree	Strongly Disagree
17. Dislike work and need to be externally motivated by various incentives and controls.	☐	☐	☐	☐
18. Are interested in producing products of which they can be proud.	☐	☐	☐	☐
19. Not only accept, but seek more responsibility for their work.	☐	☐	☐	☐
20. Have a negative attitude toward their company because they feel they don't get paid enough.	☐	☐	☐	☐
21. Want to satisfy their needs for self esteem, personal growth and accomplishment.	☐	☐	☐	☐
22. Should be trained to do one primary job.	☐	☐	☐	☐
23. Can develop their capabilities, and are motivated to do so.	☐	☐	☐	☐
24. Are more content to earn minimum wage than to work hard for higher wages.	☐	☐	☐	☐
25. Prefer to be told what to do. They dislike responsibility and have little ambition to get ahead.	☐	☐	☐	☐

SCORING YOUR SURVEY

SCORING INSTRUCTIONS: Your response to each statement has been assigned a score of 1, 2, 3 or 4 points. Refer to the "Score Key" to determine your score for each statement. For example, if your response to statement #1 was "Strongly Agree," give yourself 1 point by circling the "1" under Strongly Agree. Continue in this manner for all 25 statements. Then total your circled points and compare it with the "FM Compatibility Rating Scale."

SCORE KEY

	STATEMENT	Strongly Agree	Agree	Disagree	Strongly Disagree
PART I	1	1	2	3	4
	2	4	3	2	1
	3	1	2	3	4
	4	1	2	3	4
	5	4	3	2	1
	6	4	3	2	1
	7	1	2	3	4
	8	4	3	2	1
	9	1	2	3	4
	10	1	2	3	4
	11	1	2	3	4
	12	1	2	3	4
	13	4	3	2	1
	14	1	2	3	4
	15	1	2	3	4
PART II	16	1	2	3	4
	17	1	2	3	4
	18	4	3	2	1
	19	4	3	2	1
	20	1	2	3	4
	21	4	3	2	1
	22	4	3	2	1
	23	4	3	2	1
	24	1	2	3	4
	25	1	2	3	4

FM COMPATIBILITY RATING SCALE

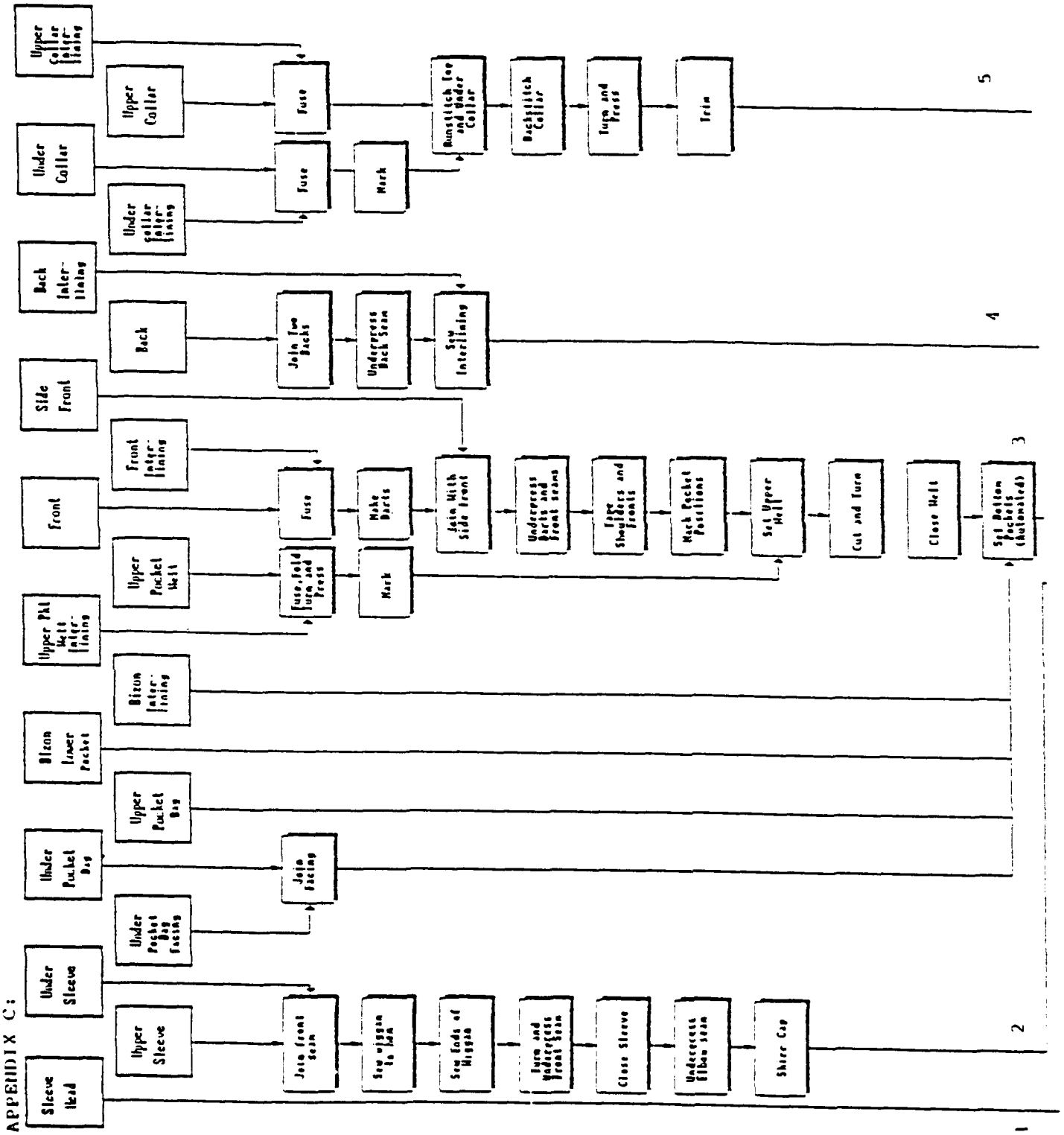
POINTS	DIMENSIONS OF MANAGEMENT PHILOSOPHY
Most Compatible with FM	
100	■ High concern with the utilization of human resources to the mutual benefit of the worker and the organization.
88	■ Optimistic attitude toward change. Workers are capable of developing their potential and are motivated to do so. ■ Workers are positively oriented toward work and willing to accept change.
75	■ Participative, employee-centered leadership style. ■ Workers are self-confident and achievement oriented.
63	■ The opportunity exists for people to work together in teams. ■ The wage payment plan is not based solely on individual output.
Least Compatible with FM	
50	■ Primarily concerned with production. More emphasis on technology and equipment than the workers. ■ Pessimistic attitude toward change. Workers have little interest in developing new skills, or lack the capacity to do so.
38	■ Workers do not identify with work and resent change. ■ Authoritarian, production-centered leadership style.
25	■ Workers lack self-confidence and have low achievement drives. ■ The job can be performed best by an individual working alone. ■ Workers are paid under a straight piecework wage plan.

COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

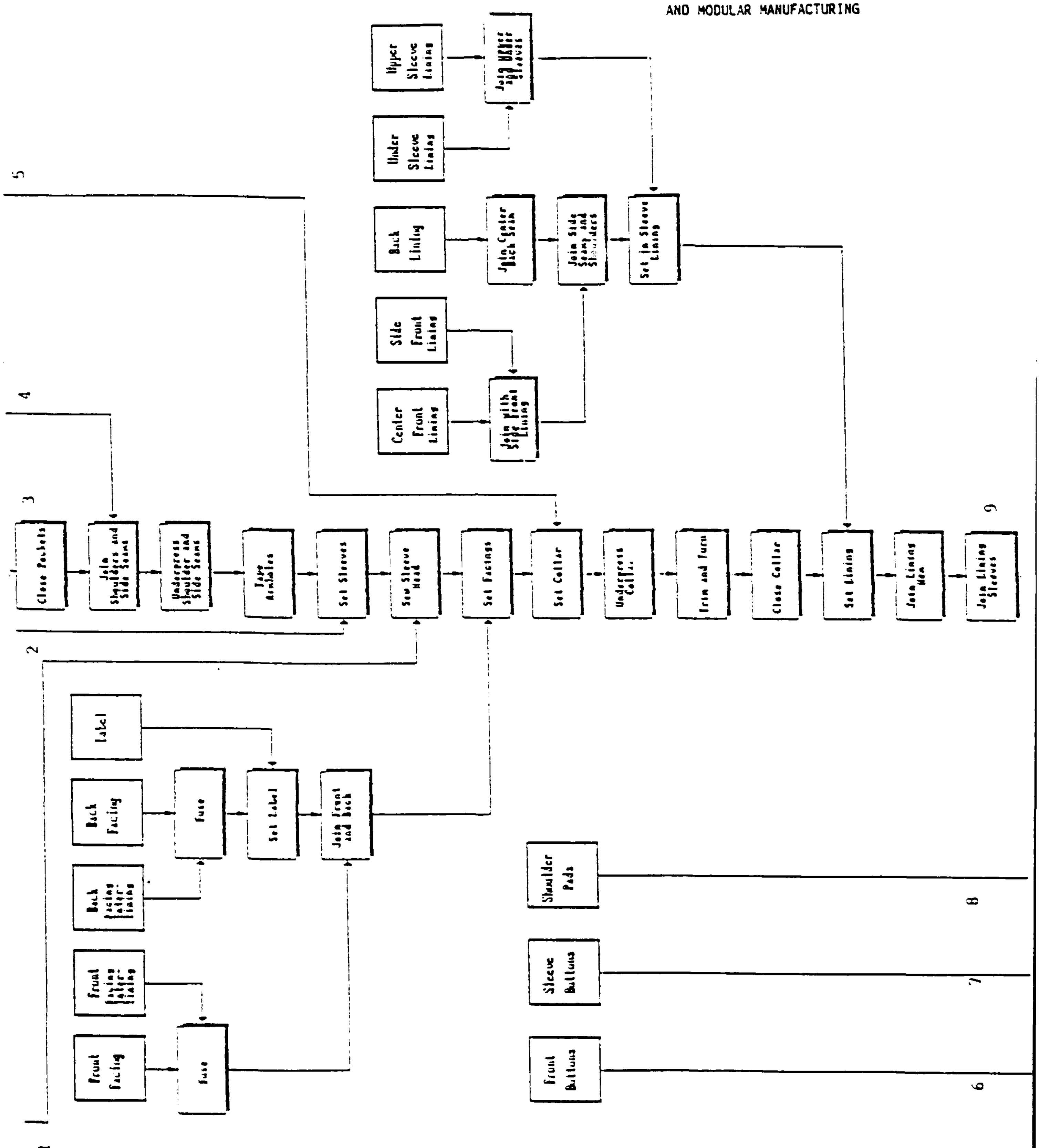
APPENDIX C:

Process Flow Chart for Ladies Jacket

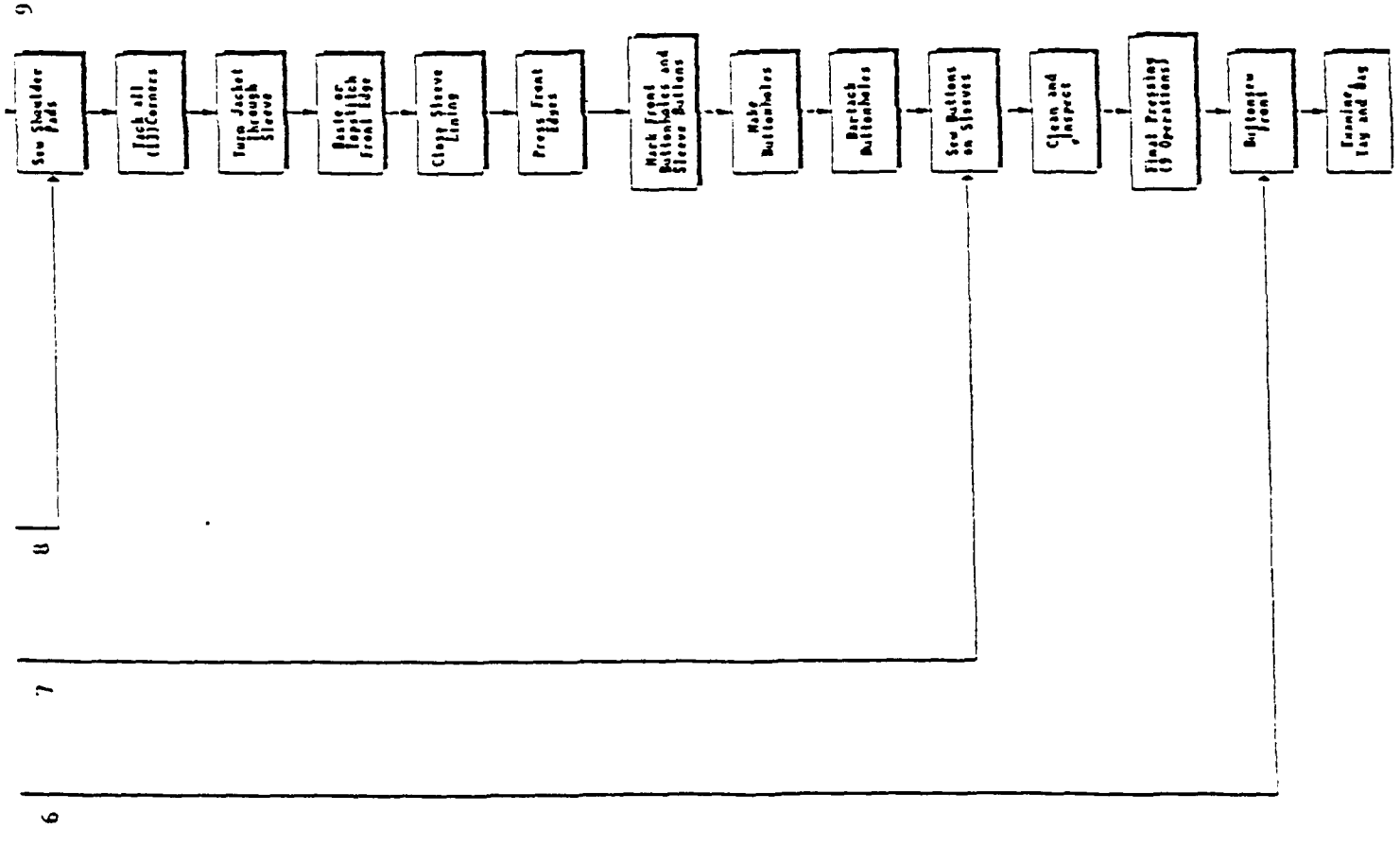
January 8, 1998



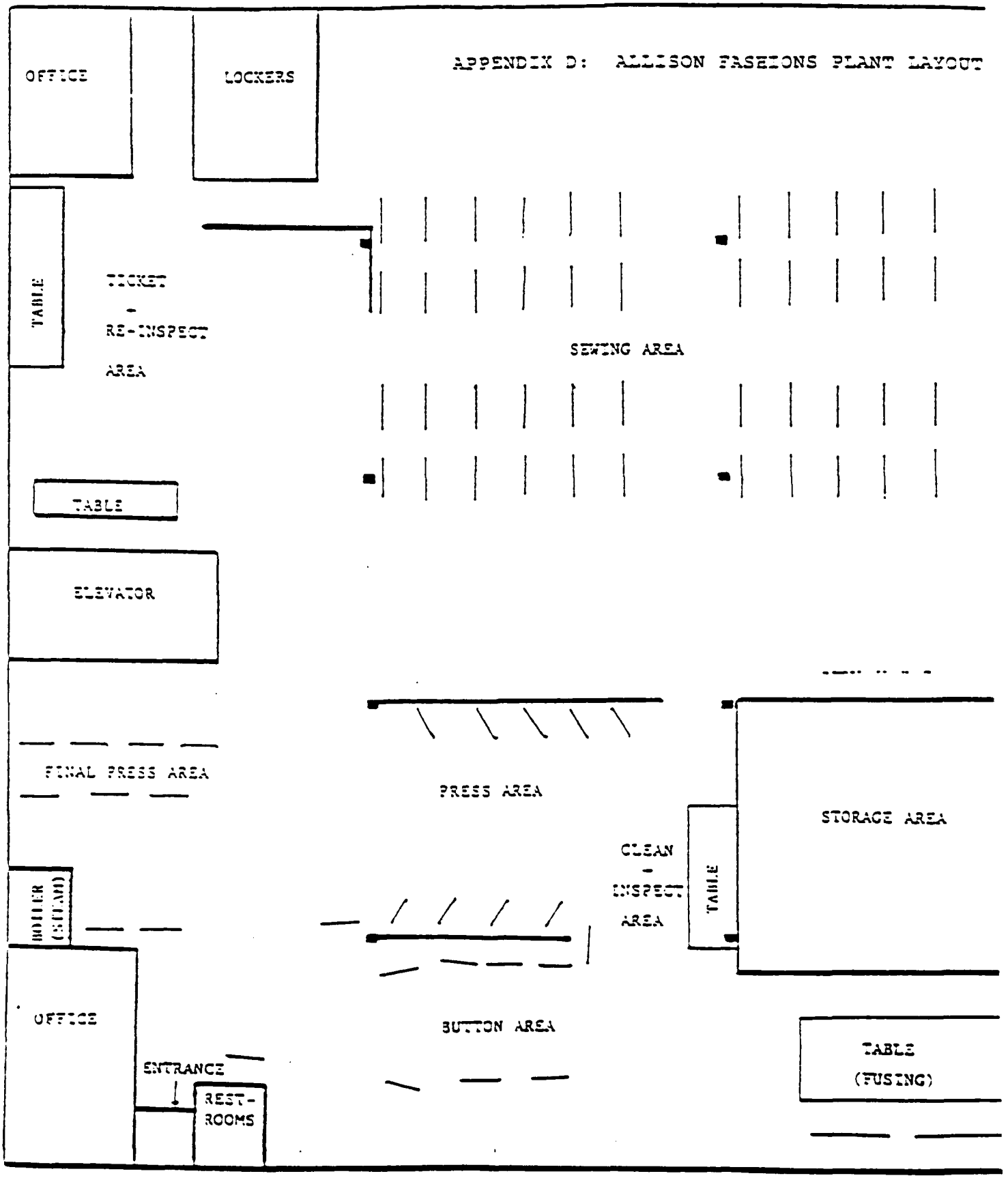
COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING



COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

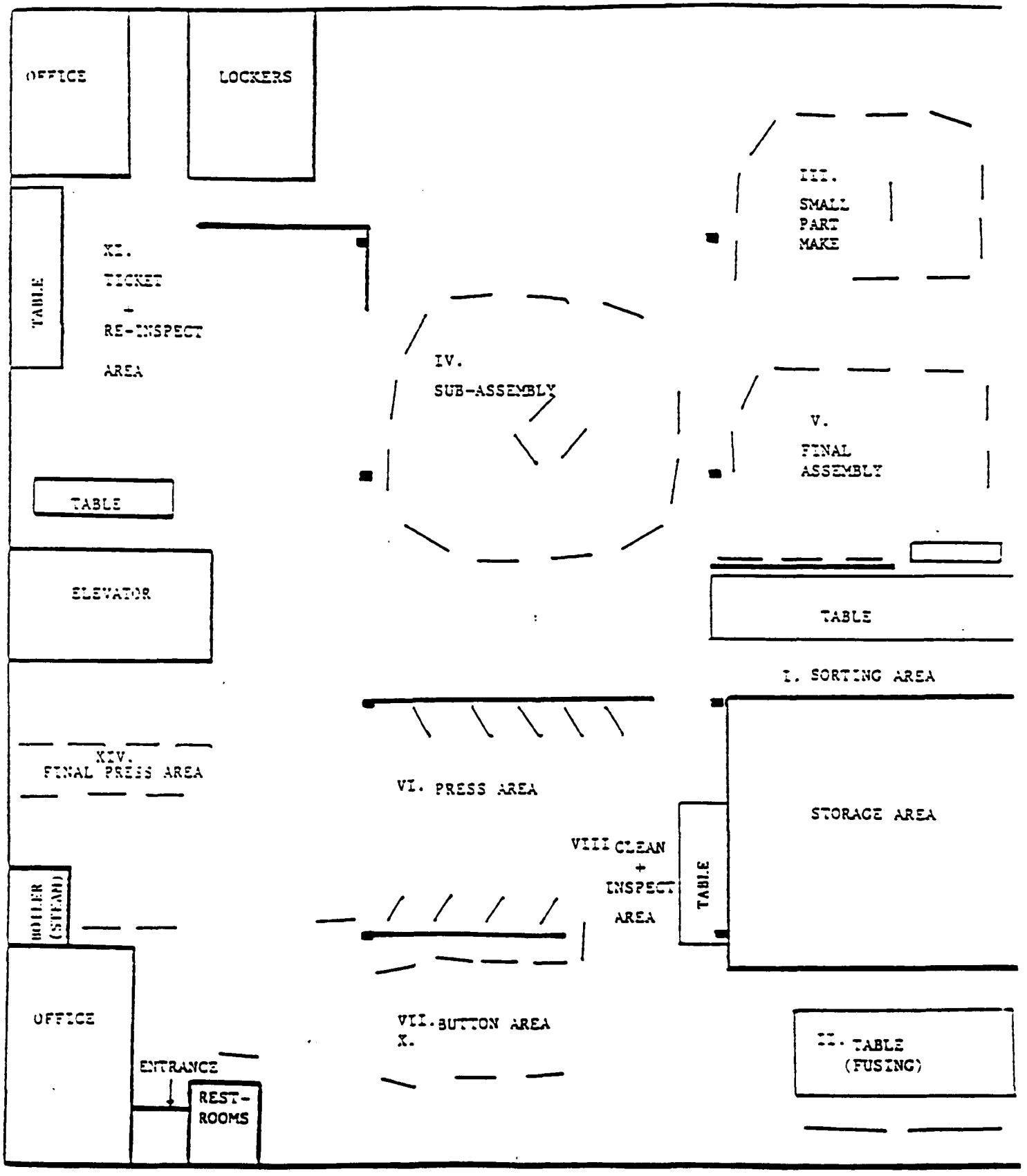


APPENDIX D: ALLISON FASHIONS PLANT LAYOUT

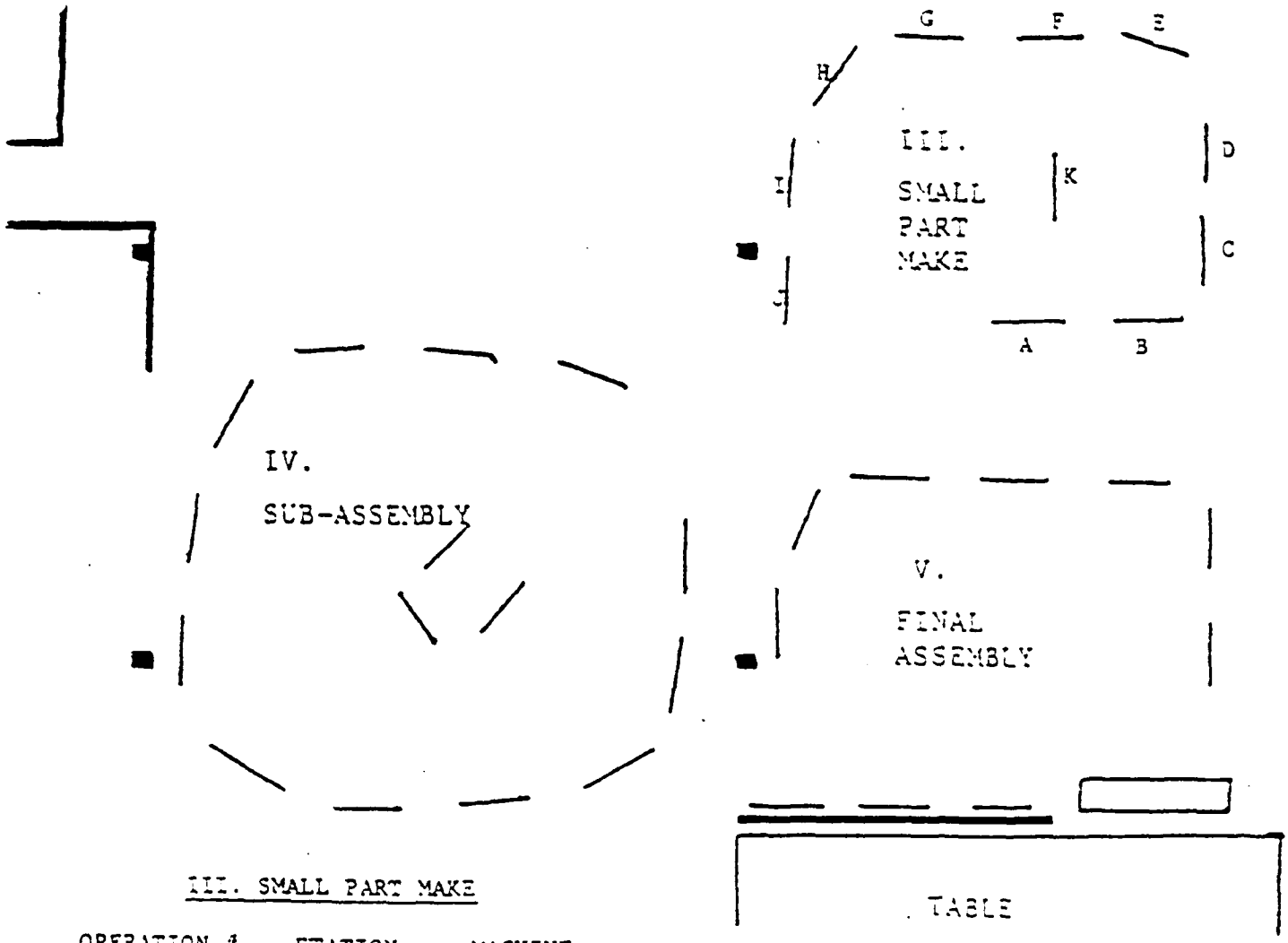


PROGRESSIVE BUNDLE

COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

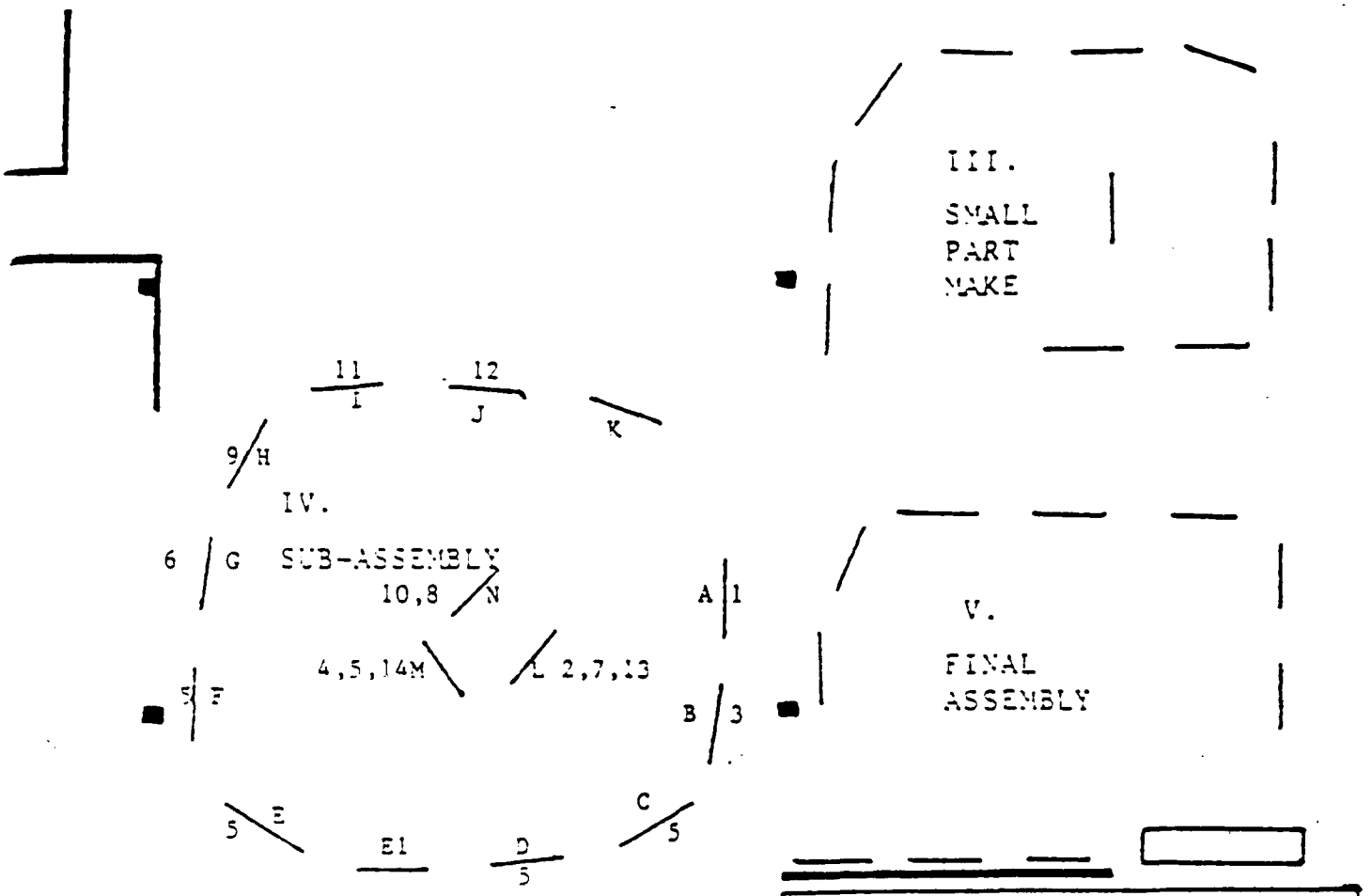


MODULAR TRANSITION



III. SMALL PART MAKE

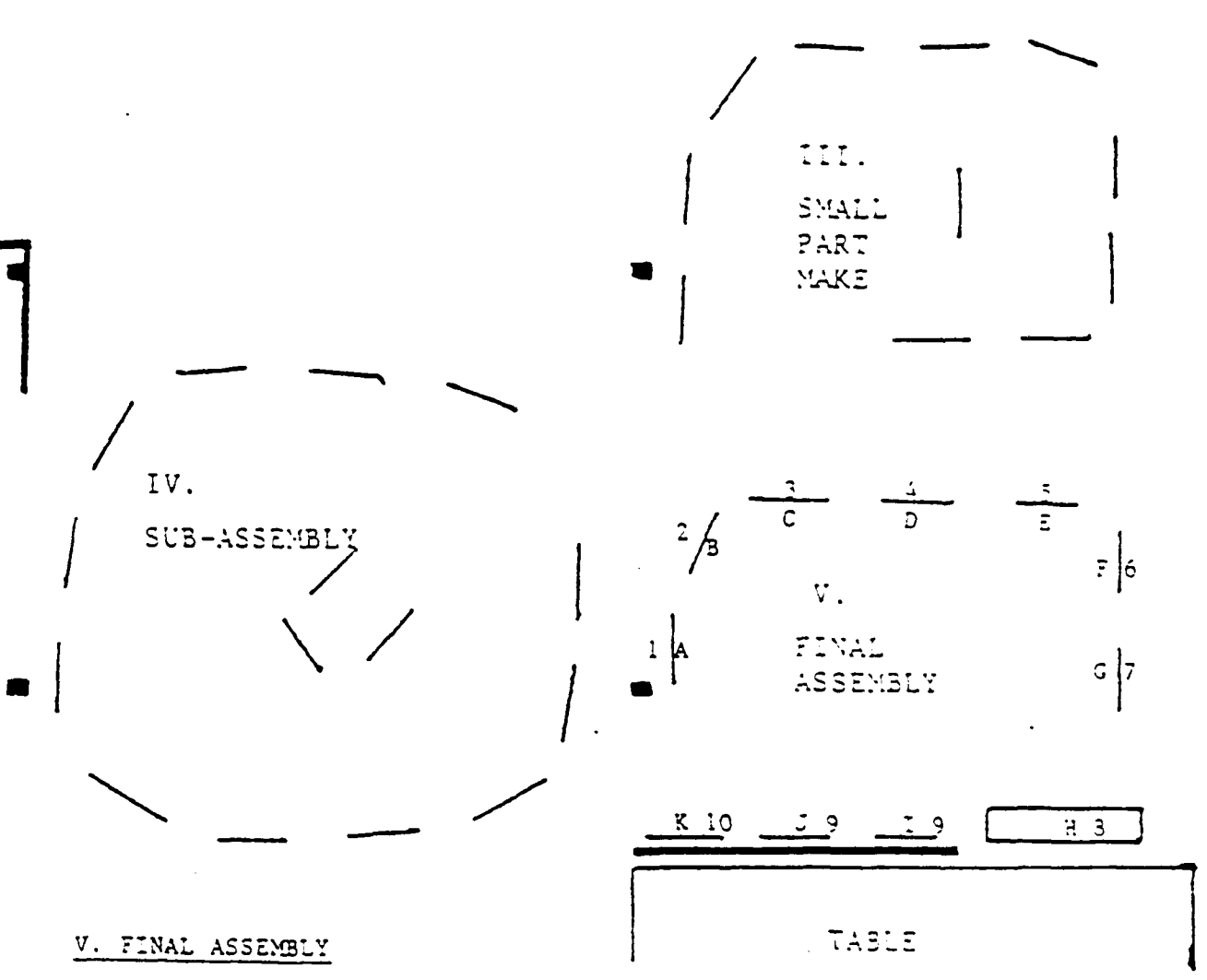
OPERATION #	STATION	MACHINE	OPERATION
	A	PFAFF LOCKSTITCH	JOIN BACK, SET INTERLINING
	B	SINGER 281-1	JOIN BACK, SET INTERLINING
	C	RIMOLDI 229	SEW STRAIGHT SEAM
	D	RIMOLDI 229	SEW STRAIGHT SEAM
	E	WILLCOX GIBBS 401-1 CHAIN STITCH (ZIPPY) WITH EDGE GUIDE	SEW SLEEVE SEAM
	G	CONSEW 230R-1	SEW ENDS OF WIGS
	F	SINGER 281-1	CLOSE SLEEVE AND VENT
	H	PFAFF (LOCKSTITCH) WITH EDGE CUTTER	SEW SLEEVE CAP, COLLAR
	I	SINGER 281-1	SEW COLLAR
	J	JUKI DDL 550-6	UTILITY
	K	HASHIMA HI 350PS IRON VEIT 4413 VACUUM	PRESS, TURN, AND PRESS WIGING



IV. SUB-ASSEMBLY

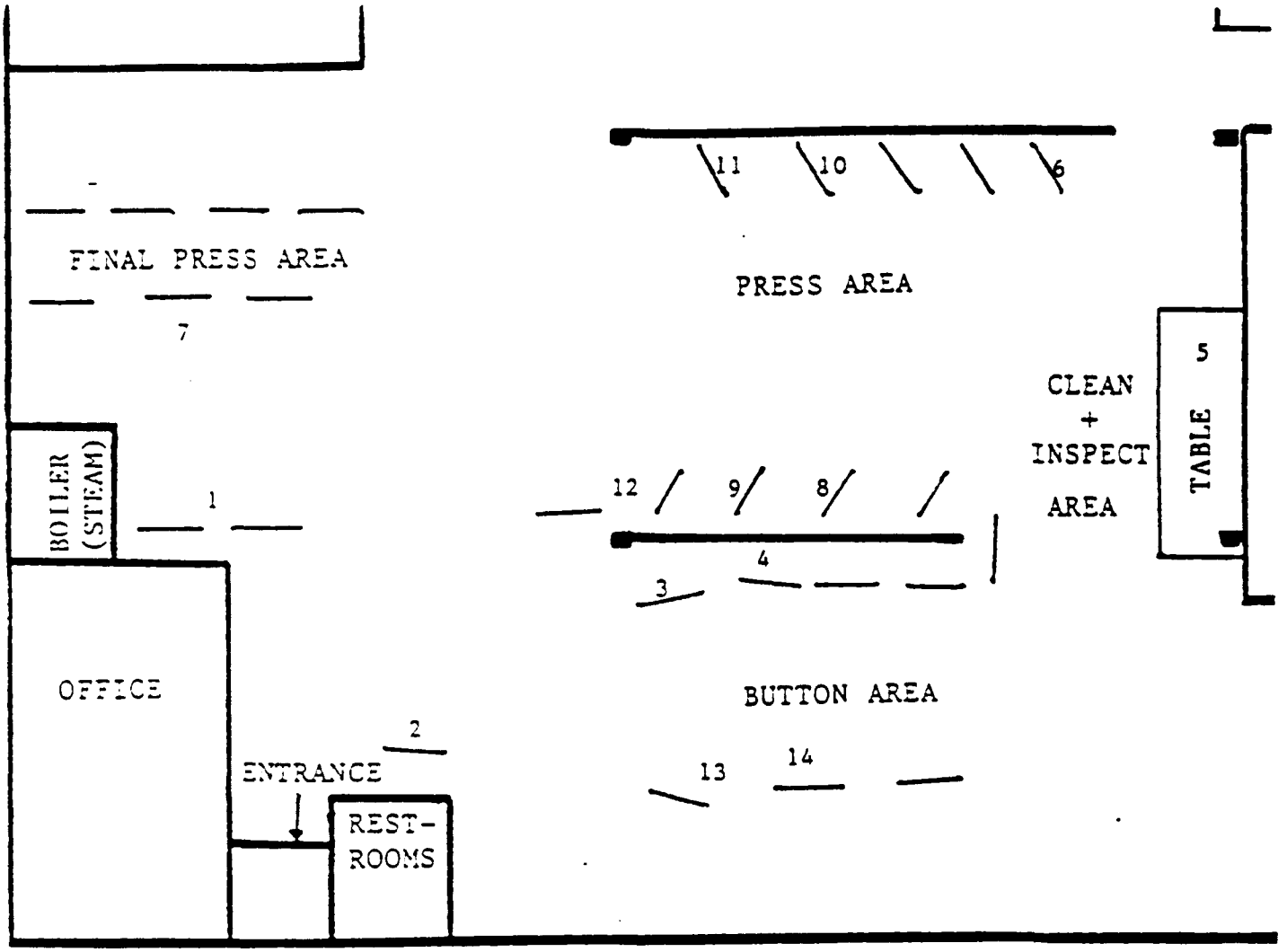
TABLE

OPERATION #	STATION	MACHINE	OPERATION
1	A	BROTHER DB2-B716 403AB	JOIN DART AND SEAM
3	B	BROTHER DB2-B716 403AB	ATTACH TAPE TO SHOULDER AND FRONT
5	C	PFAFF LOCKSTITCH	SET DOUBLE BEASAN
5	D	PFAFF LOCKSTITCH	SET DOUBLE BEASAN
	E1	EAGLE LT2 B831-3	
5	E	BROTHER DB2-B716 403AB	SET DOUBLE BEASAN
5	F	BROTHER DB2-B716 403AB	SET DOUBLE BEASAN
6	G	BROTHER DB2-B716 403AB	JOIN SHOULDER SIDE
9	H	BROTHER DB2-B716 403AB	SET SLEEVE
11	I	PFAFF LOCKSTITCH WITH EDGE CUTTER	SET FACING TO BODY
12	J	BROTHER DB2-B716 403AB	SET COLLAR
	K	JUKI DDL5550-6	UTILITY
2	L		BUST DART AND SEAM
7	L	HASHIMA HI 350PS IRON	BUST SHOULDER AND SIDE SEAM
13	L	VEIT 4413 VACUUM	BUST COLLAR SEAM
4	M	TABLE	MARK FRONT FOR PKT.
5	M		CUT AND TURN WELT
14	M		SCISSOR AND TRIM COLLAR CORNERS
8	N	SINGER W/ TAPE FEED	SET TAPE AND ARM HOLE
10		AND CYLINDER BED	SET SLEEVE HEAD



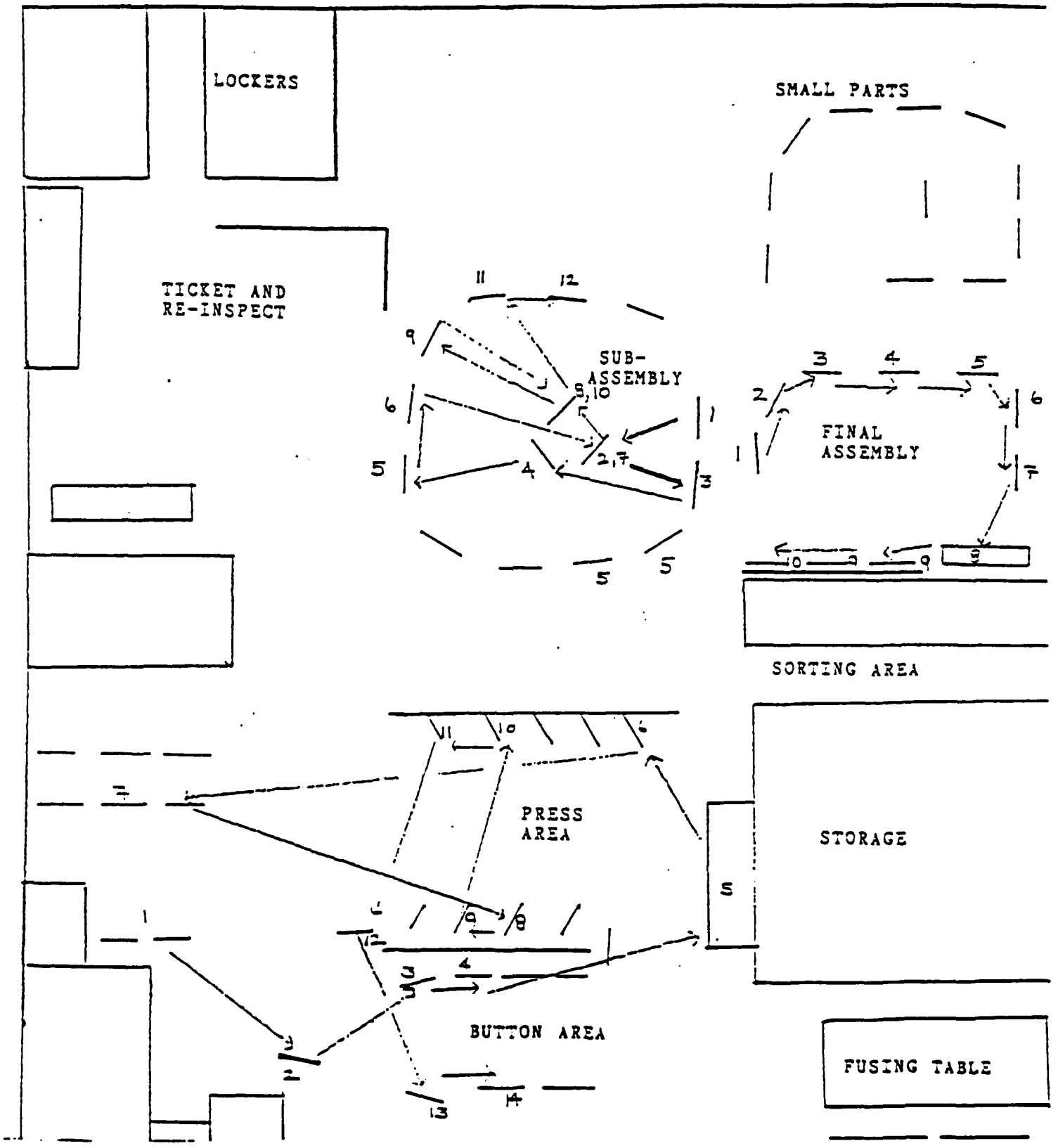
V. FINAL ASSEMBLY

OPERATION #	STATION	MACHINE	OPERATION
1	A	PFAFF LOCKSTITCH	BACK STITCH FACING
2	B	BROTHER D82-13716403AB	CLOSE COLLAR
3	C	PFAFF LOCKSTITCH	SET LINING TO BODY
4	D	SINGER 281-1	ATTACH LINING TO BOTTOM
5	E	BROTHER D82-13716403AB	ATTACH LINING TO CUFF
7	G	SINGER CYLINDER BED	TACKING: SLEEVE (2),BOTTOM (5), SHOULDER LINING TO SHOULDER, UNDERARM LINI TO UNDER ARM BODY.
6	F	PFAFF CYLINDER BED	TACKING SHOULDER PADS.
8	H	TABLE	TURN JACKET BODY
9	I	SINGER 410W110	BASTE STITCH EDGE (101)
	J	SINGER 281-1	TOP STITCH EDGE (301)
10	K		CLOSE SLEEVE OPENING



PRESSING AND BUTTON

1. PRESSING FACING EDGE
2. MARK BUTTON HOLES
3. MAKE BUTTON HOLES
4. BARTACK BUTTON HOLES
5. CLEAN
6. FORM PRESSING
7. SHAPE BODY
8. BLOCK ARM HOLE
9. PRESSING UPPER ARM
10. CREASE COLLAR
11. SHAPE LAPEL
12. TUCH UP / LINING
13. PUT ON BUTTON
14. PUT ON BUTTON

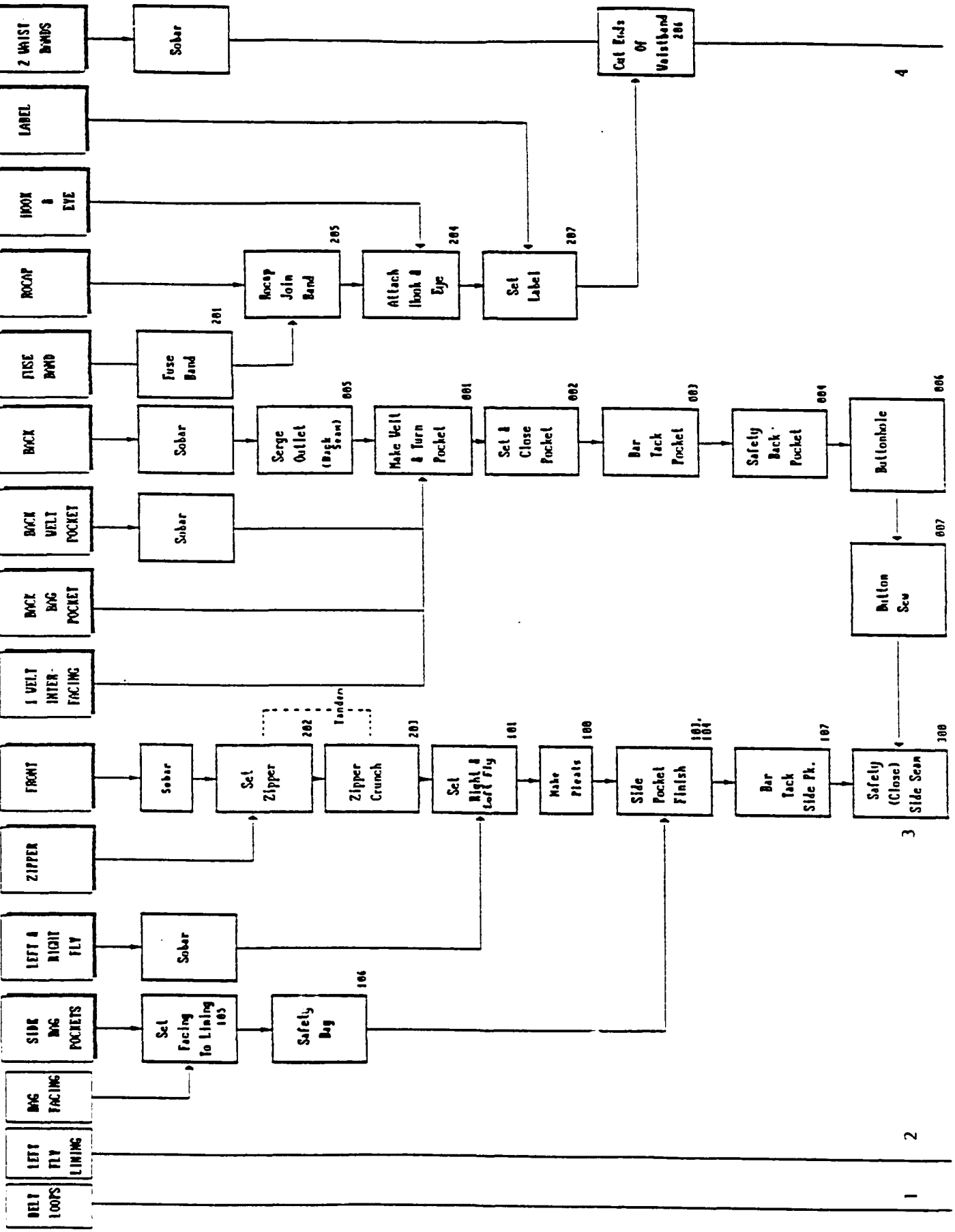


MODULAR WORK FLOW

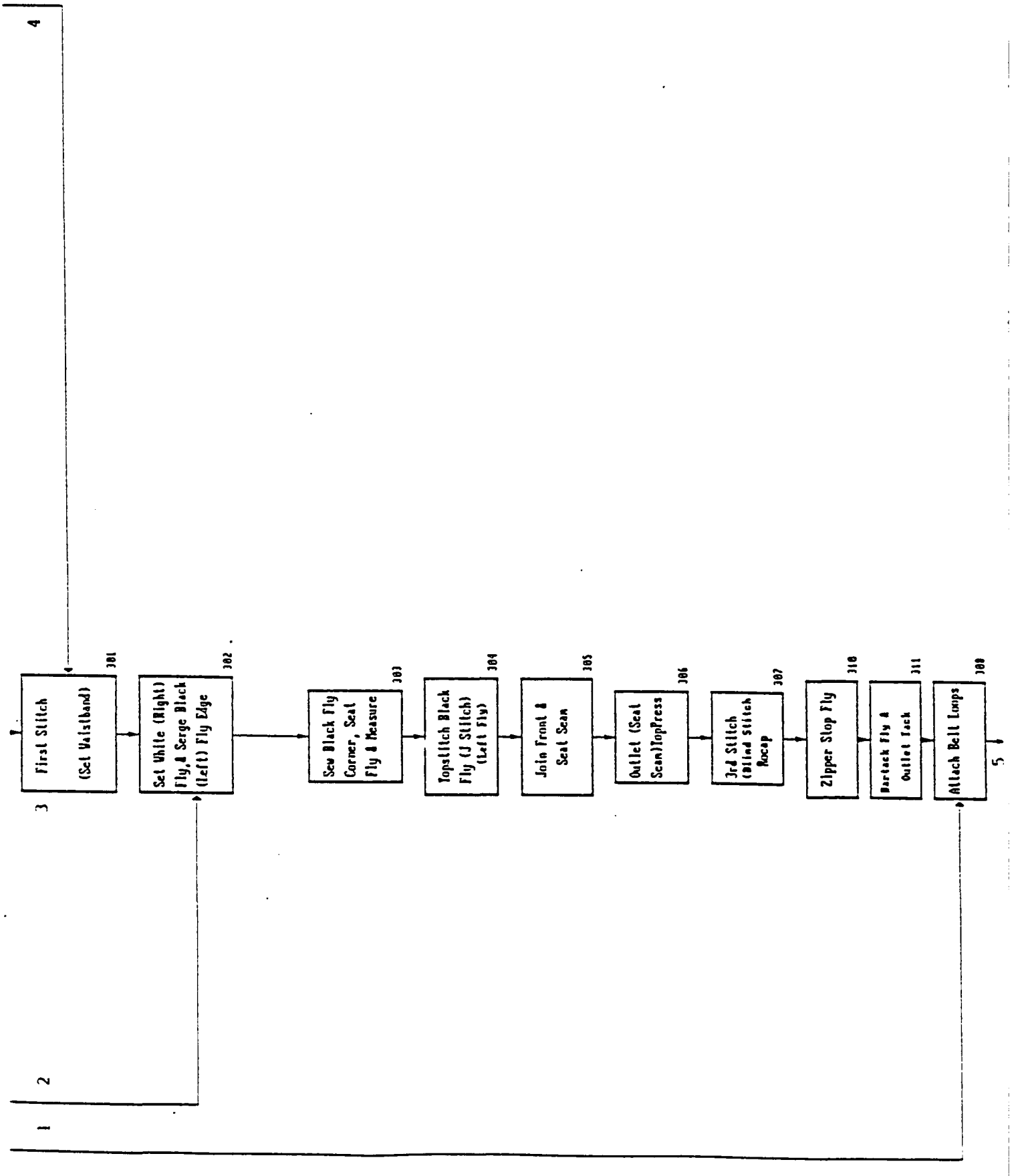
COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

APPENDIX E:

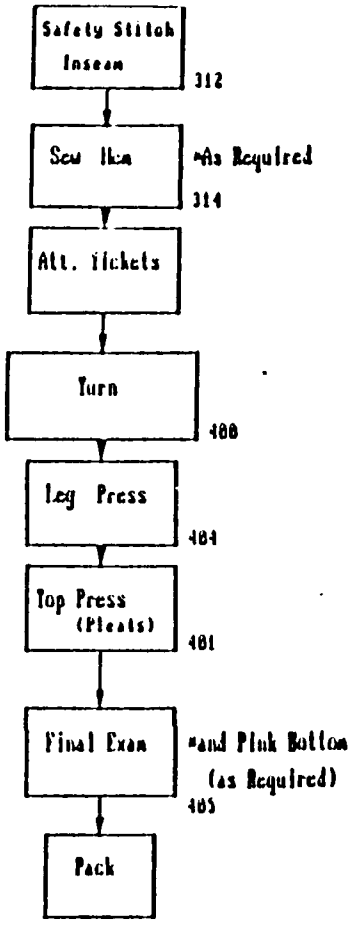
FLOW CHART FOR MEN'S & BOYS' PANTS Triple A



COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

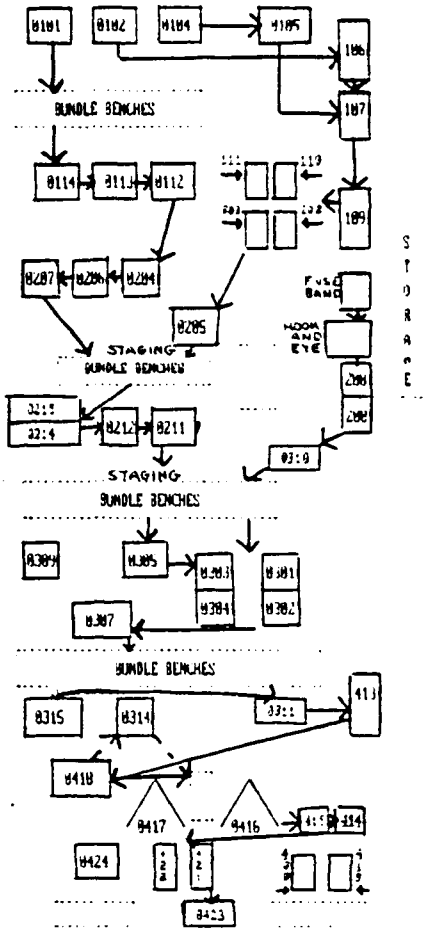


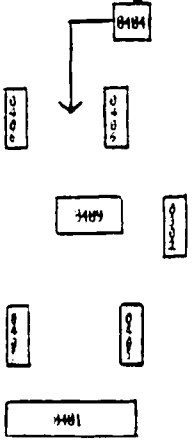
COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING



**CHANGES HAVE NOT OCCURRED DURING THE MONTH OF MARCH

01	01	REECE	BACK POCKET CUT	
01	02	BROTHER	SIDE POCKET FACING	
01	04	UN.SPECIAL	FLY SET	
01	05	SINGER	WAISTBAND PLEAT	
01	06	YAMATO	SERGE POCKET	
01	07	TALON	ZIPPER	
01	09	UN.SPECIAL	SET ZIPPER/CRUNCH	
01	10	BROTHER	SIDE POCKET SET	
01	11	BROTHER	SIDE POCKET SET	1
01	13	BROTHER	BACK POCKET FINISH	
02	02	BROTHER	SIDE POCKET SET	
02	03	BROTHER	SIDE POCKET SET	
02	04	SINGER	BACK POCKET BARTACK	
02	05	SINGER	SIDE POCKET BARTACK	
02	06	YAMATO	BACK POCKET SERGE	
02	07	UN.SPECIAL	SERGE BACK OUTLET	
02	08	UN.SPECIAL	ROCAP WAISTBAND	
02	10	REECE	LABEL/CUT ROCAP	
02	12	YAMATA	SERGE OUTSEAM	
02	14	YAMATA	SERGE OUTSEAM	1
02	15	YAMATA	SERGE OUTSEAM	
03	01	UN.SPECIAL	FIRST STITCH	
03	02	BROTHER	LEFT AND RIGHT FLY CORNERS MEASURED	
03	03	UN.SPECIAL	FIRST STITCH	
03	04	BROTHER	LEFT AND RIGHT FLY CORNERS MEASURED	
03	05	UN.SPECIAL	WELT SEAM	
03	07	UN.SPECIAL	LEFT FLY TOPSTITCH	1
03	11	UN.SPECIAL	THIRD STITCH	
03	14	PFAFF	FLY CATCH 2 SHT INSM	
03	15	PFAFF	BACK JOIN	
04	01		TRIM AND INSPECT	
04	04	SUNCO	TURNER	
04	05	NEW YORKER	LEGGER	
04	06	NEW YORKER	TOPPER	
04	09	N.HAMPTON	PINKER	
04	13	SUSSMAN	SEAMBUSTER	
04	14	JUKI	SET AND TACK LOOPS	4
04	15	YAMATA	INSEAM	
04	16	SINGER	ZIPPER STOP/FLY TACK	
04	17	SINGER	ZIPPER STOP/FLY TACK	
04	18	YAMATA	INSEAM	
04	19	SINGER	SET AND TACK LOOPS	
04	20	JUKI	SET AND TACK LOOPS	
04	21	JUKI	SET AND TACK LOOPS	
04	22	JUKI	SET AND TACK LOOPS	
04	23	REECE	ATTACH SIZE LABELS	
04	24	UN.SPECIAL	SET RIBBON ON TUXEDO PANT OUTSEAM	
09	02	NATMAR	THERMOSET-BRAND LABEL W/ HEAT AS NEEDED	

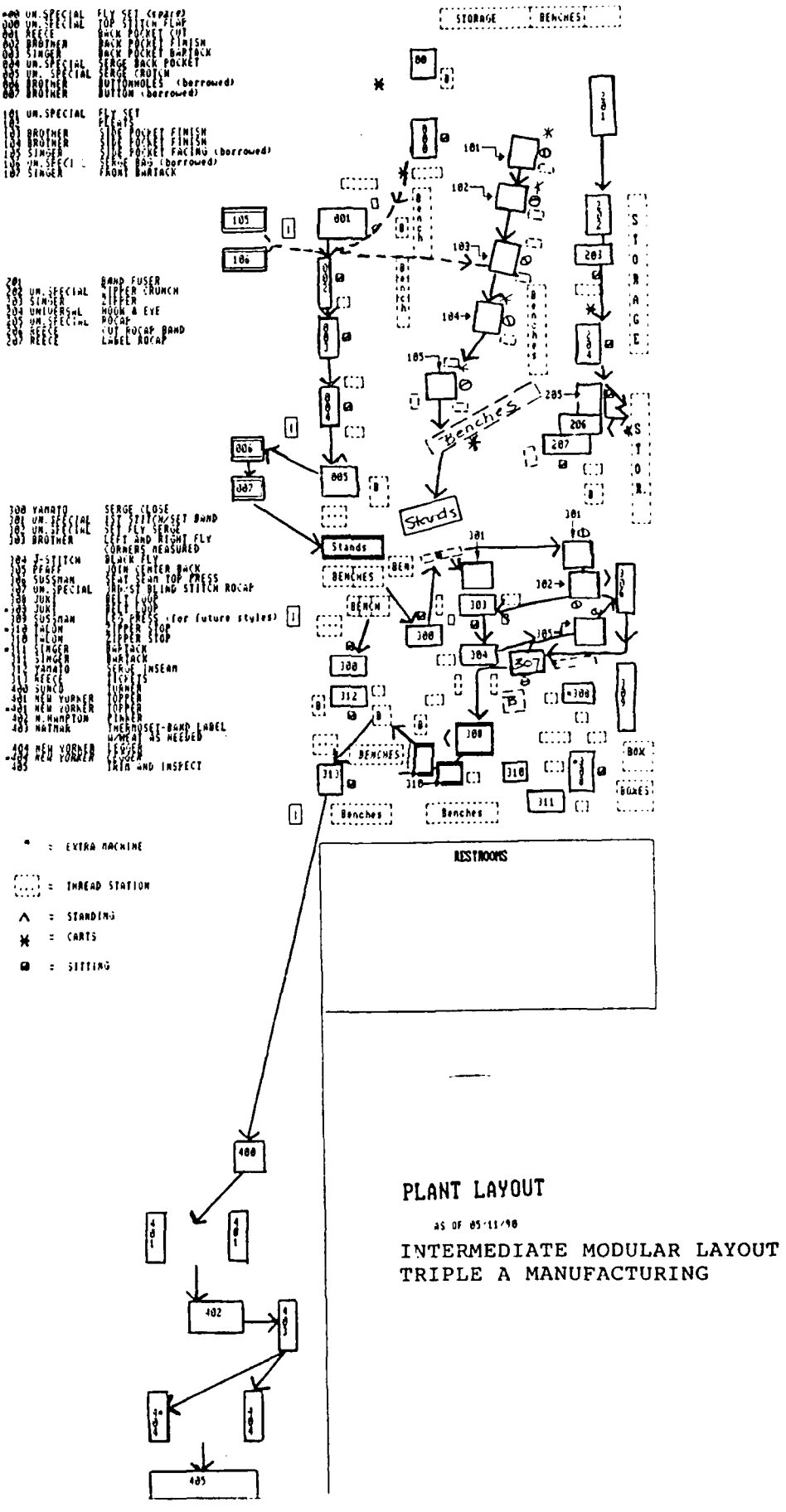




PLANT LAYOUT

APPENDIX F: MODULAR LINE TRIPLE A MANUFACTURING

COMPARISON OF COST AND PRODUCTION
BETWEEN A TRADITIONAL BUNDLE SYSTEM
AND MODULAR MANUFACTURING

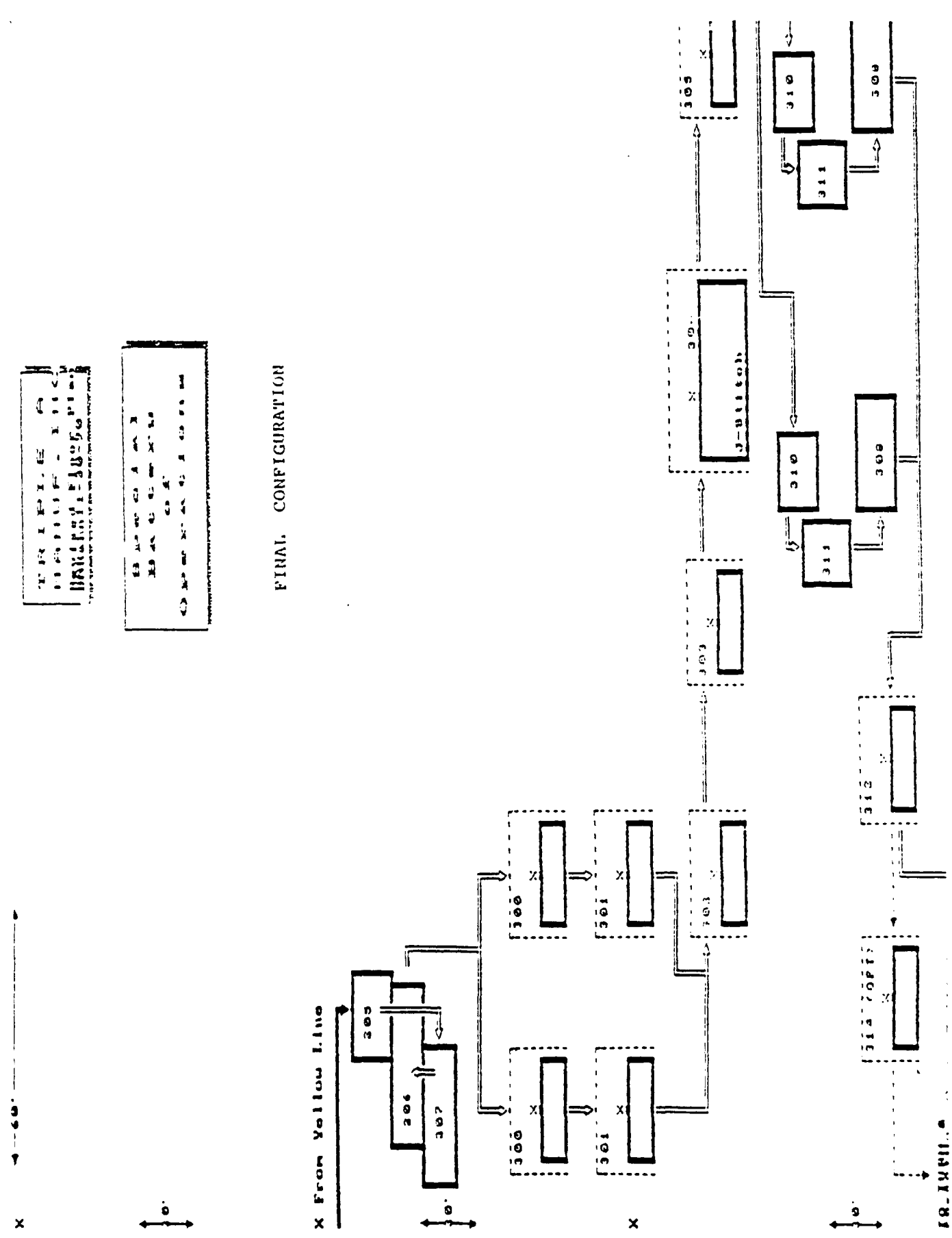


PLANT LAYOUT

AS OF 05/11/90

INTERMEDIATE MODULAR LAYOUT
TRIPLE A MANUFACTURING

FINAL CONFIGURATION



APPENDIX G

G.1. Group Dynamics Overview

In recent years there has been a recognition of the fact that in any business an often untapped resource that can deliver a competitive edge is the people who work in that business. It is important to take advantage of new technology and modernize methods of production, but people should be recognized for their vision of changes that could take place which would increase productivity and output.

With the move toward modernization of equipment and deskilling of operations, a key element to success is flexibility in manufacturing. Flexibility in manufacturing requires maximizing the involvement on the part of the operators, with cross training, encouraging teamwork, and the soliciting of ideas from the operators. If management is willing to extend praise, awards and recognition of employees' contributions they will most often discover a vast resource waiting to be tapped. Of course, financial incentives should be included in the incentive package and should be understood by the employees from the start. Flexible manufacturing may take the form of modular manufacturing which requires the formation of a group or team of operators who will work together to produce a subassembly or complete garment.

Changing the attitudes of the workers towards wanting to work within a group and help each other is the biggest behavioral obstacle to overcome. Operators have been working for themselves, on a piece rate, therefore the switch to working as a team is a big change in the way they work and think. It can be extremely difficult to get the operators to accept that there are advantages to working in groups. Management will have to be ready to lead the workers through this change, enabling them to understand the concepts and application.

Several ways that this can be accomplished are: by conducting intensive training programs for all levels of shop floor employees; group recognition; and incentives, both financial and other. All of this may not be enough to motivate employees to perform well under the new conditions. It is extremely important that there be a good relationship between management and workers. Once workers understand the importance of working as a team and helping each other they will attain the performance levels necessary for the success of a group effort. It is management's challenge to motivate employees to work as a team.

Understanding how to motivate a workforce is the key to unlocking human potential. To understand motivation, it is important to realize that employees work together in three very different ways: they are independent and prefer to work alone; they are competitive and have conflicting interests; and, they are team oriented and work toward common goals. The first two characterize the employees' behavior in many manufacturing shops today. The last is what many shops are trying to cultivate.

Many workers who have been working at the same job for a long time are possessive of their work and don't want anyone else to do it. These workers may actually be demotivated to work in a team, while others are motivated. With this type of worker, the transition to a group may need to be gradual so that they have less resistance than they would to sudden change.

These three motivating forces are the basis of D.C. McClelland's **Work-Needs Assessment Theory** which follows:

G.2 The McClelland Model

McClelland, the leading researcher on self-concept, has studied human behavior for many years and has theorized that people are motivated by three basic needs: achievement, affiliation, and power. He has further asserted that although all of us possess all three needs, we possess them in varying degrees; one person's highest-priority need may be achievement, whereas another person's may be affiliation or power.

The following is a brief description of each need and the ways in which a high degree of each translates into behavior in an organizational setting.

Achievement

People with a high need for achievement enjoy challenging work, but they also want to ensure that they will succeed; tasks that present so great a risk that success is improbable do not interest or motivate them. Consequently, they tend to set conservative goals.

Achievers plan ahead to avoid serious problems in their undertakings, but the planning function itself is not a source of motivation for them. They enjoy tasks for which they are personally reponsible for the outcome and with whose resulting success they can be closely associated. They are quite concerned with meeting appropriate deadlines and experience great anxiety about any project until it has been completed successfully. In addition, they require frequent reinforcement consisting of "hard" data such as sales figures, standards, and so forth.

Affiliation

People with a high need for affiliation direct their energies toward the establishment and maintenance of effective working relationships with others. It is the need for affiliation that prompts people to examine the "human" side of decisions that are made within organizations. When this need supersedes that for achievement or power, the concern for receiving approval from and being liked by peers, supervisors, and subordinates becomes a critical factor in decision making and implementation. Whereas achievers focus on deadlines and the objective aspects of decisions, people whose highest-priority need is affiliation focus on the interrelations that exist among those who are to be affected by the implementation of decisions. As group members, they try to maintain harmony and mutual respect among members while the group undertakes its function or objective.

Power

Power, in terms of McClelland's model, can be seen as the ability to overcome resistance in achieving an objective or goal. People with a high need for power are usually quite fluent. Because they enjoy arguing and confronting conflict, speaking skills are important to them. In an organizational setting, they tend to prefer autocratic decision making ("I make the decision, you implement it"), and they tend to see situations as win/lose ("I win, you lose").

Those whose highest-priority need is power are frequently political realists who evaluate situations in light of their political implications and determine a course of action on the basis of the outcome of their evaluations. When combined with a low need for affiliation, a high need for power may lead an individual to consider people as a means to an end, and the value of establishing and maintaining satisfactory relationships in the organizaton may be lost.[1]

Productivity is the ultimate goal. The essential ingredients to achieve this goal are satisfied customers, high standards, team spirit, and concern for workers. Management, workers, and customers should all be the winners.

Management's methods should nurture productivity. Workers possess the potential to grow and develop and are willing to accept responsibility. Under the right conditions they will set goals and fulfill their needs to belong, for achievement and acceptance, and for using their skills.

It also needs to be understood that people have different talents which are suited to various types of jobs. People work best when their abilities, interests, aptitudes, and temperaments are matched to their jobs.

All behavior is directed toward goal achievement. Goals are either positive, when one moves towards what they want, or negative, in the sense of avoiding the undesirable. Management's challenge is to motivate workers towards positive goals and good performance. Recognition, responsibility, the nature of work, achievement, and opportunities for growth and advancement are motivators which make people work.

If workers are allowed more independence, productivity can be improved. If workers work in teams, this independence can be used to improve productivity through the sharing of ideas and solving problems.

Two factors are absolutely essential to create an atmosphere that will be conducive to teamwork: a good manager/worker relationship, and motivation of workers to accept new ideas. It is essential that management works out a healthy relationship with labor. If the workers don't trust management, training or attempts to implement new ideas are doomed to failure.

It is only with motivated workers that a program of establishing teams can succeed. The motivation can be brought about by various methods such as conducting training classes, allowing workers to have the choice of whom to work with in a team, and financial incentives such as profit sharing.[2]

Teamwork promotes the use of concepts such as cross training, job rotation, and flexibility. In the assembly line environment where the flow of work is continuous, if a worker suddenly faces a problem, asking for help from his co-workers is the simplest solution. It therefore makes sense that teamwork is quite useful to the assembly line environment. Multi-skilled operators offer the added advantage that the production system is able to respond quickly to changes in the market demand.

All engineering students are familiar with Frederick W. Taylor and the concept of one best way. If the workforce is to be given more flexibility, then this concept may no longer be the best to follow. Flexibility allows for different ways to get the job done; there is no best way. There are many factors to be considered - different people work different ways, or the raw material may be different.

The old methods of manufacturing, of taking time and motion studies to maximize efficiency and worker-machine interfaces, create demotivating jobs. Today people demand quality in their work life; as a result we have new strategies of work design. Job enlargement (adding more tasks to a job), job rotation (rotating employees among different jobs), job sharing (two employees share one job) all allow employees greater freedom and challenge in their work. Another fairly new concept is job enrichment. The idea behind job enrichment is to build into jobs more opportunity for personal achievement and the recognition of that achievement, more responsibility and challenging work, and a greater oppcrtunity for individual growth and advancement. These new strategies are all possible within a team.

Skill variety, task identity, and task significance contribute to the psychological state of experienced meaningfulness of work. Autonomy contributes to the experienced responsibility of work outcomes. Feedback contributes to the knowledge of work results. The model further advocates that three psychological states affect employee satisfaction and motivation. The three psychological states are:

Experienced meaningfulness - the person must experience the work as generally important, valuable, and worthwhile.

Experienced responsibility - the individual must feel personally responsible and accountable for the results of the work he performs.

> Knowledge of results - the individual must have and understanding, on a fairly regular basis of how effectively he is performing the job.[3]

Management will probably feel the affects of the change even more than the floor staff, and will probably require the most intensive training. The supervisor's job content will change drastically; the fulfillment of this new job will require new communications skills. This is important to acknowledge and understand because without management leading the way these changes cannot take place successfully. The effect of management on the outcome of changes within an organization cannot be stressed too often.

Once the decision to enter into flexible manufacturing has been made, comprehensive training in its basics is needed for all employees. Such a program should:

1) Develop a strategy or organizational change to integrate business objectives with petitionary management and methods.
2) Assign a management/employee team to assess plant-wide training needs and monitor the programs that are set up.
3) Teach a full range of team-building skills, from problem solving to conflict resolution.
4) Give employees the technical and statistical skills necessary to analyze work problems.
5) Assure that the training staff is dedicated to sharing its training knowledge and being a resource for the team.

Training for flexible manufacturing involves no new revelations or secret formulas. However, more emphasis will be placed on people issues and employee involvement, and less on developing high skills in a single job.[4]

The approach to the formation of a team is essential to its success or failure. The selection of the members of the first team within a factory that has previously been on progressive bundle system is crucial to the future of that method within that plant. A strong team that is willing to make the change to modular manufacturing and be successful at it is what is required to show both management and other operators the advantages of modular manufacturing. The selection process should start with asking for volunteers. From these volunteers the best candidates should be selected based on their ability to work well with others, their operating skills, and their willingness to learn new operations and methods.

Selecting members for a team always requires consideration of their personalities, their adaptability to change, and their ability to absorb training in interpersonal relations and communications.[5]

Basic to the success of a flexible manufacturing system is meeting physical and psychological maintenance needs (how people are treated as an employee.) These needs can be divided into six key areas:

1) **Physical.** Work layout, job demands, work rules, equipment, location, grounds, parking, aesthetics, lunch facilities, rest rooms, temperature, lighting, and noise.
2) **Economic.** Wages, increases, profit sharing, social security, workmen's compensation, unemployment insurance, retirement, paid leave, medical insurance, tuition, and discounts.
3) **Security.** Fairness, consistency, reassurance, friendliness, seniority rights, grievance procedures, the long term health of the plant and the company.
4) **Orientation.** Job instruction, work rules, group meetings, shop talk, newspapers, bulletins, handbooks, letters, bulletin boards, and grapevine.
5) **Status.** Job classification, title, furnishings, location, privileges, relationships, and company recognition.
6) **Social.** Work groups, coffee groups, lunch groups, social groups, office parties, carpools, outings, sports teams, and interest groups.[6]

The transition from performing one job to becoming a flexible operator can be difficult; this transition can be successful if the following guidelines are followed:

* Teach operators the steps and critical points of each operation in your product. Even if they will not perform the operation themselves, they must appreciate how critical each operation is and where they fit.

* Make sure trainers use appropriate teaching methods for job skill training. Basically, this means a step-by-step method:

1. Prepare the learner. Put the person at ease and express confidence in his/her ability to learn. Find out about the person's prior experience and other interests. This information can be used later to relate the new job to behaviors already learned.

2. Demonstrate the operation to be learned at normal speed. Show models of successful operators. Allow the learner to examine quality products.

3. Demonstrate the operation step-by-step. Point out critical procedures, methods, tools, and safety notes.

4. Allow the learner to do the job. Don't worry about speed - focus on method. More than 70% of speed can be obtained immediately, if the correct method is learned.

5. Give specific information on the learner's performance. Use accurate examples that show the learner what you have observed. Also, relate actions to results. For example, explain: "When you pull too much like that, the two pieces of fabric don't feed evenly and it looks like this." Trainers should be taught key points and common mistakes and know how to correct them.

6. Follow-up. Allow some time for the individual to practice the new skill, then check back to see that he/she is progressing as expected.

* Rotate operators among machines. This helps break dependencies on "my machine".

* Provide for work experiences with a variety of co-workers. This gives team flexibility in accepting new members.

* Provide training that improves communication skills among team members and develops conflict resolution skills.

* Give group feedback as well as individual feedback.[7]

After the members of the team have been selected it is important to build the team. This is a process where the members of the team examine their own behavior and develop courses of action which will aid them in their work. Team building efforts will reveal both functional and dysfunctional behaviors. By discovering the dysfunctional behaviors of the team the group can develop solutions to these problems and overcome them.

During the process of team building the group will be able to explore the personalities in the team to the extent of discovering its natural leaders and intergroup relations. The level of trust and openness within the group will be raised during the processes of resolving conflicts and solving problems.

What sabotages teamwork is most often ineffective leadership on the part of management. There appear to be two styles of management that suppress teamwork: the first style is known as "hierarchical" or "formalistic" and the second as "circular". In the first style the meetings are formal and basically superficial as the team spends most of its time ratifying the leader's demands without the opportunity to critique the demands. In the second form harmony and equality are the prime values and the meetings lack the give and take of collaboration.

Basic principles of teamwork training include: Focus on the situation, issue, or behavior, not the person; maintain the self-confidence and self-esteem of coworkers and supervisors; take the initiative to make things a little better; maintain good communication, practice active listening, and develop techniques to shape behaviors.

Teaching operators to move from job to job within a module on their own, without depending upon a supervisor to tell them to do it, is one of the more difficult concepts of teamwork to train. Instead of being in business for themselves; operators must now learn to work with and depend upon others. That is quite a transition.

A group incentive program, in which everyone's earnings depend upon everyone's performance, helps get the message across quickly and dramatically.[8]

According to Rubin, Plovnick and Fry in Task-Oriented Team Development there are four keys that must be considered in the team development process. These elements are:

* **Goals.** Individuals must understand and accept the goals of the group.

* **Roles.** Team members must know what others want and expect from them. Ambiguity in role expectations produces stress and hampers performance.

* **Procedures.** All members must know how to get work done together (e.g., making decisions, solving problems, managing time and conflict.).

* **Relationships.** Put simply, people who like and respect one another usually work together more effectively than people who don't.[9]

A team that is well integrated will have the feeling of a family structure and will therefore be able to withstand more stress. It will create higher motivation and enthusiasm; there will be more commitment and better performance.

Team dynamics is the internal mechanism that determines team effectiveness. It is composed of interrelated variables that collectively determine how the team process functions.[10]

The importance of time and efffort spent toward positively building a team cannot be over-stressed. The results of the time properly spent can be spectacular; an efficient and effective team. However, if the time spent building the team is misdirected or simply not spent, the results will most likely be disastrous. The approach to team building should be thorough and well thought out.

According to Mark Frohman, in his article, "PM Participative Managment: The Missing Ingredients", there are six conditions for succes and you must have all six. They are:

1) **Unfreezing** - Non-participation is unsatisfactory and not to be tolerated. It is necessary to restructure and break old patterns.

2) **Champions** - Someone in the organization who is fully behind the cause. Also a sub-champion, an employee respected by both management and employees, who is known to speak up.

3) **The Purpose Factor** - Company needs to state the purpose and long range strategy of the organization in order to achieve employee participation.

4) **Training** - All employees, including management, need training. Problem solving skills are essential, as well as learning how to participate.

5) **Parallel Circuits** - Flexible methods of structure on tasks. Regularly scheduled meetings with supervisor and subordinates are necessary to update one another on performance problems, coordination requirements, and status of plans.

6) **Multiple Menus** - Must be able to be effective in administration and financial and keep everyone up-to-date in both areas. Supply information to the group concerning success or failure.

Team members become better problem solvers, thanks to greater communication and mutual team support. Creativity and innovation can be expected to permeate the team interaction. As the team develops and grows, it becomes more cooperative and reflects greater coordination. Ultimately, productivity is significantly increased through the team's synergism. A collective strength is formed that is far superior to the sum of individual strengths, enabling the individual within a team to grow and produce.[11]

There are several different methods for group problem solving. However, prior to using one of these methods it is necessary to identify the problem and set up an agenda for the meeting.

Group decision making can be used to try and identify the underlying causes of the problem, even before it is used again to solve it.

The chairman (boss) should, at a minimum, be able to formulate an agenda that identifies the topic for discussion. This should be done in detail.

To get as much as possible out of the decision process, try to identify the type of problem.

The next step is formulating and distributing an agenda.

Factors to remember:

* Making sure everyone has a copy of the agenda prior to the meeting merely increases the chances that everyone will be prepared.

* Provide background information concerning the purpose of meeting and an outline of what stages the meeting will move through and what is to be accomplished.

Decision-Making Procedures

There are at least four distinct decision-making procedures: the ordinary group procedures, brainstorming, statistical aggregation, and the nominal group technique. Each is directed toward discovering the best solution for the problem.

Ordinary Group Procedure entails calling a group together, presenting the problem, and asking for comment and discussion. The chairman (boss) usually has control so things don't get out of hand.

The ordinary group procedure is very unstructured. As a result, few alternative solutions are suggested, and groups often choose the first satisfactory solution. Because of the lack of structure, discussions can seem endless. Fatigue sets in; people are anxious to get out of the meeting and move on to other things; the last solution suggested is often seized just so the meeting can be completed.

Brainstorming is a technique for generating ideas. The success of a brainstorming session depends on the group members following a few simple rules. First, people are encouraged to generate as many ideas as possible, even wild ideas. Second, no evaluation of any kind is permitted during the brainstorming meeting. The pros and cons of an idea are not allowed--ideas are suggested without additional comment. Finally, people should "piggy back" or build on other people's ideas.

Statistical Aggregation uses the ideas of a group of individuals, but does not ask these people to interact with one another in a group setting. It is limited to quantitative problems. Several people make individual estimates of the best answer to a problem. The estimates are collected, and one of a variety of aggregation procedures is used to dete ine the final solution.

Nominal Group Technique (NGT). After the problem is clearly stated, group members sit together quietly and individually generate as many alternative solutions as they can. After about 15 minutes, ideas are presented in round-robin fashion. Each individual presents a single idea, taking turns, until all of the groups ideas have been presented. The chairman (boss) records them in full view at the front of the room. This process psychologically separates the ideas from the individual who has suggested them.

A brief discussion focusing primarily on the clarification of each idea is next. This discussion may generate additional ideas, which are also recorded. After everyone is clear about the entire set of suggestions, a voting or rating process is used to reach the group decision. Each group member might vote for the five alternatives that he or she feels are best, ranking-ordering them from one to five. Alternatively, each of the ideas can be rated on a 10-point scale, from good (1) to bad (10). Votes or ratings are done on private ballots. Tabulations are made by the chairman (boss) and when the votes show a winner the group is finished.

Portions of different techniques can be combined and/or modified to fine tune the problem-solving procedure.[12]

With a modular manufacturing strategy the human resource skills of management will need to be enhanced to enjoy the fruits of a successful venture. It is our hope that the previous discussion of some of the basic concepts will stimulate management and cause them to review their plans to integrate group dynamics and personnel development into their strategies. Failure to do so will result in wasted expenditures generating negative cash flow and production results.

FOOTNOTES

1. McClelland, D.C., The Achieving Society, New York: Irving, 1979.

2. Sadtry, Ravi, Teamwork On An Assembly Line: An Analysis Through Case Studies An Simulation Models Of Actual Assembly Facilities, Rensselaer Polytechnic Institute, December 1989.

3. Ibid.

4. Making The Revolution Work, How to Implement Flexible Apparel, AAMA, 1989 Report of the Tech. Adv. Committee.

5. Ibid.

6. Ibid.

7. Bennett, Billy, "Steps To Flexible Operators", Bobbin, April 1989.

8. Making The Revolution Work, How to Implement Flexible Apparel, AAMA, 1989 Report of the Tech. Adv. Committee.

9. Johnson, Cythia Reedy, "An Outline For Team Building", pg. 48-52, Training, January 1986.

10. Littlejohn, Robert F., "Team Management: A How-To Approach To Improved Productivity, Higher Morale, And Longer Lasting Job Satisfication", Management Review, January 1982.

11. Ibid.

12. Ibid.

APPENDIX H:

THE PROFIT - SHARING MOTIVATION

The International Apparel Research Conference
November 14, 1990

By
Ed Hill
Site Director
Clemson Apparel Research
Clemson University

The Modular Manufacturing concept, also known as Flexible Manufacturing and Production Teamwork, has become quite popular in the United States apparel industry in recent years and is looked upon as one of the solutions to the problems facing the industry. It is particularly seen as beneficial in improving product quality and timely deliveries as well as employee morale, turnover, and attendance. However, the U.S. apparel industry has long relied on piecework to track employee production and to determine operator pay. Changing to the modular system will require that paradigm to be broken so that the coordinated team atmosphere can be emphasized. This paper will address one alternative compensation system that is applicable to modular manufacturing teams.

The Individual Incentive System (piecework) has been the primary method of operator compensation in the United States apparel industry since the early 1800's. In the "cottage industry" approach where workers at home made products for various industries, the method of payment was based upon a certain number of dollars for each unit produced. Mass production apparel factories were set up in the mid 1800's and the production of the garment was broken down into individual operations while the method of payment remained piecework. It became clear that this system provided a high level of incentive for operator productivity and provided a very accurate method of tracking costs.

Although the system has been refined substantially since that time, the basic concept remains intact. The system has served the apparel industry well in that it provides a compensation plan that is directly related to operator performance. It has facilitated a simple and accurate costing system and it serves as a tool for measuring not only operator effectiveness but also total manufacturing plant effectiveness. In addition, the statistics generated by the piecework system provide valuable information to management for use in scheduling and line balancing.

The most important aspect of the Individual Incentive System, however, is that it provides a method of recognizing and rewarding production workers for exceptional performance. It has been called " the most fair way to pay anyone." Production workers become entrepreneurs and those who have the greatest amount of skill and who are willing to put forth more effort are paid the most money. When the system works well and is properly maintained, it is the best method known for motivating operator productivity.

More than 90% of U.S. apparel firms use the Individual Incentive System as the method of employee compensation in the stitching department.

However, the proliferation of style, new equipment technologies and changes in the labor force have diminished the effectiveness of this system. Style change is a growing reality in the U.S. apparel manufacturing industry. In a global market, apparel manufacturers in low-wage-rate countries are much more cost effective in producing the basic apparel product. This reality dictates that long production runs of the same product will continue to be a rarity in U.S. apparel plants. The niche for U.S. apparel manufacturers may well be short runs of high fashion products. Because the piecework system is based upon the premise that production operators will be allowed to remain on a single operation long enough to establish a high efficiency level, this system is clearly not effective in the style environment that is becoming increasingly common in the U.S. apparel industry.

Another problem created by short runs of high fashion products is balance within the manufacturing plant. When an operator is allowed to stay on a single operation for an extended time, not only does efficiency increase but performance also becomes much more predictable. Plant management is therefore capable of balancing operations to achieve maximum overall productivity. However, constant style changes within a plant causes an increase in the number of operations performed by each operator, a decrease in individual operator performance and a drastic increase in the role of supervision and management in balancing the overall operation.

The piecework system encourages the production operator to remain on the operation on which there is the greatest amount of skill. This obviously causes a decrease in the net flexibility of the manufacturing operation. Given the obvious need to create an apparel plant environment in which style and product changes are welcome, the piecework system is clearly no longer effective.

The most important short fall of the piecework system is that it decreases an operator's concern for quality. By definition, piecework encourages an operator to produce the maximum number of units in a given period of time. There is little incentive for the operator to want to produce a high quality product. The only connection to quality in the piecework system is a negative one, in

that operators will be forced to repair any defective work that is detected during "on standard" payroll conditions.

Finally, it is clear that the apparel production worker of today is not inclined to work on the production piecework system. Based on Clemson Apparel Research studies, workers are clearly more interested in a job that will allow interaction with fellow employees and one that will provide an opportunity to be involved in the total workplace. Piecework is not designed to offer those opportunities.

The Modular Manufacturing concept, in which operators are organized into teams of workers, seems to address each of the problems facing the apparel industry today. An effective modular installation is known to provide significantly improved product quality because operators are encouraged to help each other. Because work-in-process levels are greatly reduced, through-put times are diminished from weeks to a matter of hours, and when there is a quality problem, only a small number of garments are to be inspected and repaired. Therefore, cost effectiveness improves in that total manufacturing costs are reduced. This is clearly contradictory to the piecework system, which encourages operators to work as an individual entrepreneur and in a competitive environment.

With an increasing number of apparel companies switching to the modular concept, there has been a great deal of experimentation on alternative methods of operator compensation. The objective has been to design a system that would encourage operators to work together as team members and to produce a high quality product in a cost effective manner.

Clemson Apparel Research has developed the Clemson Apparel Productivity Share (CAPS) System in order to meet the following objectives:

- Encourage product quality
- Encourage operator flexibility
- Encourage better employee - company relationships
- Provide a monetary incentive for increased productivity
- Encourage an atmosphere of teamwork

CAPS is a spreadsheet system that allows the apparel manufacturer and team members to accurately predict in advance of production the amount of money available to the team members and the company, for production of a quality product beyond a certain standard level. By a pre-production calculation of these statistics on a particular style, a goal is established for the team members and indirect employees associated with the team. This system operates on a personal computer (Macintosh, IBM, or compatibles) and uses Microsoft Excel or Lotus 123 software.

CAPS assumes that the group of operators assigned to a modular team would be paid a guaranteed hourly wage for all hours worked. One of the many problems with the piecework system is that production operators lack a clear understanding of what the hourly wage will be beyond the plant's minimum wage structure. By providing a more generous hourly wage, possibly equal to the highest plant base rate or the plant average hourly earnings level, production operators are relieved of the stressful uncertainty associated with the piecework system. However, the productivity incentives provided through the CAPS concept will allow overall plant production costs per unit to remain acceptable. The idea of a generous hourly wage is essential in order to avoid one of the more serious problems with the piecework system: drastic fluctuations in operator take home pay. A properly motivated production team will, nevertheless, keep production costs in line.

The program is composed of three primary worksheets: direct labor; indirect labor; and main. Beginning with the direct labor worksheet, the first step in using the system is to list the name of the module, the names of the individuals assigned to that group and their rates of hourly pay. CAPS will then calculate the total number of people and the average hourly wage within each module (Figure 1).

A philosophical point should be considered in determining average hourly wages for team members. In addition to this figure being a generous one, it is appropriate that all of the team members should be paid the same amount, as in Figure 1. After all, the message being conveyed is that all of the team members should share equally in the performance of the team's duties. However, a case may be made for assigning different rates of pay for individual team members. The most obvious example here is that the efficiency level may vary greatly among team members. It is certainly possible that some team members may be proficient at

several operations, while other team members may know only one operation. Furthermore, a company may want to reward employees for longevity with a higher rate of hourly wage. These and other conditions may fully justify unequal rates of pay for team members. This is a judgement that must be made by plant management. The system allows this capability, as is noted in Figure 2. The system currently provides for five different modular teams composed of up to 20 operators each. Depending upon individual company needs, the number of modules and the number of employees per module may be customized as needed.

The user would then move to the indirect labor worksheet and list the names of the persons, job titles, wage rates and modular assignments for all indirect persons involved (Figure 3). You will note here that ten indirect persons may be assigned to each of the five modular teams. Again customization is possible. The objective of this worksheet is to provide for the possibility that indirect persons, such as supervisors, technicians, quality inspectors, and service persons may be allowed to participate in the bonus potential of the modules with which they work. Certainly these persons play a vital role in the productivity of any modular team. By providing the opportunity for participation in the team bonus these indirect employees will not only have a much greater incentive for improving the productivity of the module, but will also feel more like true members of the team. An important principle of the modular concept is that all employees (production operators, indirect employees and company management) feel the sense of belonging to the same production team. Monetarily connecting the indirect labor employees to the production team serves to accomplish this objective. This worksheet is, however, optional and may be omitted from subsequent calculations. You will note that module 4 has no indirect persons assigned and the company's bonus share is listed as the remaining portion after the operator's bonus share is deducted.

Also on the indirect labor worksheet you will notice that the amount of money per unit above standard for each indirect person's modular assignments is posted. This information is obtained from the main worksheet for each module as will be noted.

Moving then to the main worksheet, the module name, average hourly wage, and number of people assigned have already been posted automatically (Figure 4). Having developed the information

from the direct and indirect labor worksheets, the user will now post pertinent information having to do with other cost factors that will be used to develop the total manufacturing cost per period and the total manufacturing cost per standard unit.

The strategy involved in the CAPS concept is that knowing direct and indirect labor costs, the user may consider all other cost factors as a percentage of direct labor. These are factors normally known by plant management and are advisable to share with their production employees. Doing so would send a clear message of cooperation from the company and would aid the production employees in developing a clear understanding of the real costs in operating a manufacturing plant.

As a percentage of direct labor, figures for direct fringe, indirect, indirect fringe, overhead and budgeted profit must now be posted. Normally, these factors will not change among modular teams or upon style changes within the plant. These factors are indicated by the examples on lines four through eight of Figure 4.

Line nine requests the user to post the sum of the direct labor content for all of the operations involved in the module. Similar to the piecework system, this figure is used to calculate the number of units that the team should be able to produce in order to meet standard. While this figure must be accurate, it is much less critical than the individual operation labor content required by the piecework system. Since CAPS includes the sum of all the operations involved in the modular team, it is less likely to cause constant criticism as in the case of the production piecework system. It is recommended that this figure be developed using a computerized industrial engineering system, offering speed and accuracy of data. It is essential that all of the information for the CAPS program is available prior to actual production. Since time studies are not possible on a new style never having been in production, a computerized standard data system using predetermined time standards is an ideal method of developing the information needed.

Line ten requests the user to post the hours per period to be used in subsequent calculations. Normally this figure would be the total hours in a single work day or a single work week. By posting "1," the system will develop the subsequent calculations based on a single work hour. Doing so would be advisable in a plant having frequent style changes.

The above information is used to develop the information posted in lines 11, 12, and 13. Line 11 indicates the total manufacturing cost per period. This is valuable information to convey to the production workers in that it serves to provide a greater understanding of the true cost of operations. Line 12 indicates the standard units per period at 100%. This is the basis of all subsequent calculations and indicates the level at which the team must produce in order to be eligible for a bonus. In other words, as seen in Figure 4, the team of seven operators producing a garment having a labor content of 0.1124 Standard Allowed Hours per piece and working eight hours per day, should be able to produce 499 units "at standard" each day. Production up to 499 first quality units per day would allow the operators to be paid the average hourly wage of $5.90. Any production exceeding 499 first quality units would provide a bonus above $5.90 per hour.

Line 13 indicates the total manufacturing cost per standard unit. This figure is developed (referring again to Figure 4) by dividing the total manufacturing costs per period by the standard units per period.

The theory of the CAPS system is that beyond the productivity level indicated on line 12, all basic manufacturing costs have been met including direct and indirect labor costs, direct and indirect fringe costs, overhead costs and budgeted profit. For production beyond the figure indicated on line 12, the total manufacturing cost per standard unit is the amount of bonus money available to be shared between the company and all the employees. The remainder of the main worksheet is used to determine that share. It is important to note that only first quality units completed and ready for shipment should be considered in determining the quantity produced.

On line 14, the CAPS system initially calculates the actual contribution of the operators as a percentage of the total manufacturing costs per standard unit. Referring to Figure 4, the indication is that 42.6% of the total manufacturing cost per standard unit is contributed by the direct labor employees. This number can be used as a guideline to plant management in determining the share provided for the modular team. This percentage is then posted in the indicated block.

Based upon all of this information, line 15 will then post automatically the operators bonus per unit above standard.

Referring to Figure 4, the indication is that for each unit produced above 499 per day, the team of seven persons would share 98 cents or 14.0 cents per unit per person as indicated on line 16.

Lines 17 and 18 provide the same information related to the company's share. It should be noted that the indirect bonus amount is deducted from the company's portion of the bonus potential. In other words, initially indicating that the operators are to be provided 50% of the bonus earned beyond the production level of 499 units per day, means that the company bonus share is 41.1% and the indirect bonus share is 8.9% as indicated on line 19.

Lines 20 through 22 provide the user with the opportunity of posting actual production figures in order to determine actua' efficiency and actual average hourly pay. These lines may be used as examples of certain productivitv levels in advance of production or may be used to develop payroll statistics after the production day is complete.

The Clemson Apparel Productivity Share System has beea designed to meet the primary objective of providing an alternative to the production piecework system for modular manufacturing teams. There is no doubt that the modular concept will play a vital role in the future of the domestic apparel industry. The Individual Incentive System seems inappropriate as a method of operator compensation for a modular team. CAPS is one of the alternatives available to the apparel industry. Information on the availability of CAPS may be obtained from Clemson Apparel Research by contacting the author.

CLEMSON APPAREL PRODUCTIVITY SHARE
Clemson Apparel Research

Direct Labor Worksheet #1

	Quality Makers	Hourly Wage
1.	Ann Smith	$5.90
2.	Beth Jones	$5.90
3.	Cindy Williams	$5.90
4.	Debra Jacobs	$5.90
5.	Edith Wilson	$5.90
6.	Freda Adams	$5.90
7.	Gloria Baldolph	$5.90
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
	Number of people in module	7
	Average Hourly Wage	$5.90

Figure 1

CLEMSON APPAREL PRODUCTIVITY SHARE
Clemson Apparel Research

Direct Labor Worksheet #2

	QualiTeam	Hourly Wage
1.	Sheryl Weeks	$6.25
2.	Helen Ward	$6.50
3.	Linda Patterson	$6.35
4.	Virginia Maory	$6.35
5.	Chris King	$6.75
6.	Frances Holland	$5.35
7.	Inez Grant	$5.50
8.	Pat Emerson	$7.00
9.	Jean Culver	$8.00
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
18.		
19.		
20.		
	Number of people in module	9
	Average Hourly Wage	$6.64

Figure 2

CLEMSON APPAREL PRODUCTIVITY SHARE
Clemson Apparel Research
Indirect Labor Worksheet

	Employee name	Job Title	Wage	Module Assignment 1	2	3	4	5
1.	Ruth Jones	Supervisor	$9.50	1		1		
2.	George Smith	Maintenance	$10.00	1	1	1		1
3.	Judy Williams	Quality	$9.75	1		1		
4.	Mary Spencer	Supervisor	$8.00		1			1
5.								
6.								
7.								
8.								
9.								
10.								

BONUS PER UNIT ABOVE STANDARD

	Mod. 1	Mod. 2	Mod. 3	Mod. 4	Mod. 5
Ruth Jones	$0.07		$0.08		
George Smith	$0.03	$0.03	$0.04		$0.04
Judy Williams	$0.07		$0.08		
Mary Spencer		$0.07			$0.09

Operator bonus	50.0%	55.0%	40.0%	45.0%	50.0%
Company bonus	41.1%	40.4%	51.7%	55.0%	42.5%
Indirect bonus	8.9%	4.6%	8.3%		7.5%

Figure 3

CLEMSON APPAREL PRODUCTIVITY SHARE
Clemson Apparel Research
Main Worksheet #1

1. Module name		Quality Makers
2. Average hourly wage		$5.90
3. Number of people in module		7
As a Percent of direct labor:		
4. Direct Fringe		26.0%
5. Indirect		33.0%
6. Indirect Fringe		26.0%
7. Overhead		105.0%
8. Budgeted Profit		6.0%
9. Labor content of entire module - SAH		0.1124
10. Hours per period		8
11. Total manufacturing cost per period		$977.98
12. Standard units per period at 100%		499
13. Total manufacturing cost per standard unit		$1.96
	actual contribution	share
14. Operators' bonus share %	42.6%	50.0%
15. Operators' bonus per unit above standard		$0.98
16. Bonus incentive per operator		$0.140
17. Company's bonus share %		41.1%
18. Company's bonus per unit above standard		$0.80
19. Indirect bonus share %		8.9%
20. Actual Team Production		550
21. Actual Efficiency		110.2%
22. Actual Average Hourly Pay		$6.79

Figure 4

MANUFACTURING TECHNOLOGY

A TALE OF TWO COMPANIES

Flexible manufacturing can help U.S. apparel companies meet the increasing demands of domestic manufacturing. Discussed are two contracting firms that have implemented variations of modular manufacturing and which exemplify the many different factors that must be considered.

by Aaron Schorr

MODULAR (FLEXIBLE) manufacturing has been implemented in many different variations by U.S. apparel companies. Factors such as the type of product produced, the size of the company and the organization's management structure must all be taken into consideration when planning a conversion to this type of Quick Response manufacturing.

In an effort to explore some of the distinctive features a modular environment can possess, a research team from the Fashion Institute of Technology, under the sponsorship of the Defense Logistics Agency Apparel Research Project, observed two apparel companies in the process of changing from the progressive bundle system to a variation of modular manufacturing.

The objective of this project was to observe the transition of the two dissimilar contractors over nine months and evaluate the successes and/or failures each had in applying the existing theories of modular manufacturing to their own firms. As these firms represent typical manufacturers, the knowledge gained from their experiences could assist others as the industry moves to develop strategies for Quick Response.

The first company had one of three lines in the same facility converting, while the other company changed its complete factory over to modular. The following is a case study that separately outlines the different aspects of these two companies in nine different areas, describing the characteristics and functioning of each flexible manufacturing system.

CONTRACTORS STUDIED

	Contractor A	Contractor B
Product:	Pants	Ladies' tailored jacket
Location:	Rural small city in Pennsylvania	Metropolitan city in New York
Language:	English speaking	English and Spanish speaking
Module size:	15-person module	50-person module
Total employees:	125	61
Labor force:	Union	Non-union

The information presented here offers some insight as to how different companies have approached the adoption of flexible manufacturing. Following each of the nine topics are corollaries reflecting upon some important points that need to be addressed in the transition process.

The summations which follow are based on personal observations made during periodic visits to each facility.

TEAMWORK

Contractor A: The workers volunteered for the module, and the current plant layout has bunched jobs with some standing operators. The layout is still in transition, as the firm is experimenting with a variety of configurations to achieve a layout that requires the least possible amount of floor space. However, this layout must still allow the operators to see if they need to switch operations to keep the garments moving through the unit.

Contractor B: The entire factory was converted to modular manufacturing and the operators were divided into seven work groups. The machines are arranged in circles, and all operations are sitting with the exceptions of fusing, buttonhole and button sew, underpressing and final pressing. These particular operations are standing because the equipment is most efficient when used by a standing operator.

Corollaries: Preplanning is essential for success in a flexible manufacturing environment. It should encompass all personnel who will be participating in the transition. In the case of these two companies, this included the operators, supervisors and support staff. In addition, Contractor A included mechanics, the engineering department, the board of directors and a union representative in the planning process.

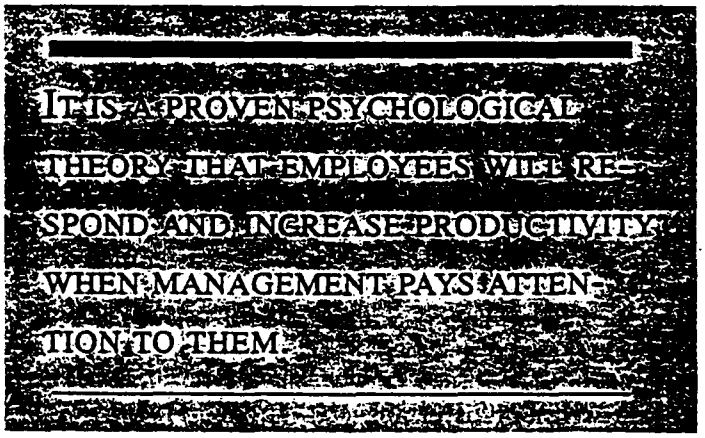
Operators were involved in every aspect of the conversion, as the nature of a module requires that the operators become partners in the venture for it to be truly successful. The union was also supportive in the case of Contractor A because it believes that the future of the apparel industry requires innovative thinking on the part of management.

Contrary to some beliefs, standing does not have to be required in a module. This observation showed that short cycle jobs having a number of operators performing these jobs during the day work well standing. However, those operators in the module who work at one job for the majority of the day can work efficiently sitting.

In both of these shops, most of the operators have a primary job within the module and work sitting at the sewing machine. Sitting is possible because work-in-process at these shops is normally about 10-18 pieces between operations, not the zero work-in-process seen in some Japanese apparel plants.

COMMUNICATION

Contractor A: The operators in this company are encouraged to work closely with a supervisor, and there is an open door policy with the owner. Team meetings have been held on an irregular basis when initiated by management. The company is in the process of changing this to a regular schedule, and the operators have determined that spokespersons



will be selected depending on the problems being discussed.

Graphs on the wall are used to chart quality, with a real-time production system advising operators of their productivity and earnings immediately. This encourages increased productivity in the unit because the operators are aware of exactly how much they have produced and what their earnings are.

There is now one supervisor per 15 employees, whereas before the conversion, there were two supervisors for every 45 employees. Under the modular system, the supervisor must split time between the module and another line in the plant. Currently, the module is taking a disproportionate amount of the supervisors' time because the operators are still being cross-trained and management does not have the group incentive or final layout in place yet.

Contractor B: The owner and plant manager are always on the floor and available for assistance. Management has attempted to have the operators meet and solve minor problems themselves. This has met with limited success because the operators are resisting this newfound freedom and responsibility. Since they have never participated in decision making before, it will take some time before the operators become comfortable with the process.

The company's employees are from a variety of different cultures, thus requiring extra effort from management to make sure that everyone understands what is happening and is participating. In some cases, communication has become a problem because the different operators can not understand each other.

Boards on the wall are used to chart productivity, and production counts are taken every hour. These counts are then posted for everyone to see, so that individual operators can monitor their productivity and bonus eligibility.

There is one supervisor for every 25 operators at this company (which was also the ratio before the conversion to modules). However, the owner is also on the floor, changing the ratio to 12.5:1.

Corollaries: For a successful modular environment, communication with the operators must be direct. Management must show a commitment, and successes and problems should be addressed immediately to reinforce positive results and eliminate negative events. In the case of both Contractor A and Contractor B, successful operator meetings have been held directly with top management.

As the supervisor's role is key in this process, it is essential that he/she must be skilled in human relations and group dynamics. Additional training may be required to reinforce the supervisor's expertise in these areas and work balancing. Managers at these two companies are constantly seeking any information or assistance that could help them understand the personnel aspects of the transition. They attended a number of small workshops and seminars, both locally and at the Bobbin Show.

In addition, senior management must meet with module members and lend moral and financial support for this undertaking. Follow-up is essential for continued success because a module can lose its momentum if it is left on its own. The module needs to be kept invigorated, and they must believe they are important to the continued success of the company.

TRAINING

Contractor A: The operators, who know at least three jobs, are being cross-trained by a supervisor and, in some cases, other operators in the module who have previously performed the operation. During the initial change, operators were guaranteed a training average, which was kept for two months. This is replaced by subsidized rates when an operator is being trained for a new or secondary operation.

Contractor B: The operators are teaching each other within each subgroup. Most are cross-trained for two or three jobs by neighboring operators, with the supervisor overseeing the operators' progress.

Corollaries: Training is the biggest investment area for

both of these companies. Financially, a training investment cannot be recouped solely through direct labor savings. The payback of training in a modular environment must be generated from reductions in turn time, work-in-process, indirect labor, utilities, gross margin from product pricing and other areas.

One myth that has been cast aside in these plants is the need to set up special training programs for supervisors and operators.

All of the cross-training has been done within the normal process of both firms. Patience, however, is a virtue, as learning curves are extended during training. Because the modular environment means that an operator will be changing jobs during the day, he or she can not build up the consistency of method and rhythm that can be attained when the operator is only performing one job, or being trained in a vestibule.

A commitment from senior management is imperative for the success of a modular group. Photo of operators in a modular environment courtesy of (TC)².

The preferred situation in a modular environment is that all operators should know all of the operations. However, a more realistic approach should be a minimum of three operations for each employee in the module. It was observed during this study that in groups of more than five operations, it most likely will not be economically feasible for the operators to learn all of the operations in the module. Neither of these companies anticipates having operators know all of the tasks within the module because of the cost factors involved.

COMMITMENT

Contractor A: The original commitment to adopt flexible manufacturing grew from a customer relationship. The customer needed the pants produced by Contractor A to complete a line, however, production needed to be changed to meet the customer's delivery needs. Ideas were entertained to determine a compromise, and the concept of a module was born.

Once the commitment was made, management reinforced the decision by making any additional resources needed immediately available to the modules. Also, engineering efforts were made to improve the workplace layouts. These efforts have resulted in some unique changes, such as new work stands, changing of the operation sequence and the bunching of ticketing and turning.

To support these changes, management went one step further by using computer software to handle all of the payroll calculations and to develop a compensation package for the new manufacturing environment.

Contractor B: The decision to adopt a flexible manufacturing system came from within the company. Management determined that modular manufacturing is the company's viable strategy for the future.

As part of this commitment, management made a number of investments to ensure the success of the modules. Duplicate workstations for specialized equipment were set up to avoid down time. Also, ergonomic chairs were installed for all of the operators, and additional funds were used to make electrical modifications to facilitate the layout of the modules. In addition, increased management and clerical time is now utilized to maintain the modular bonus system.

Corollaries: It is a proven psychological theory that employees will respond and increase productivity when management pays attention to them. Some of the quality and productivity improvements within a modular group can be directly attributed to this phenomena. It is imperative to success that the commitment to the modular group is sustained by senior management. This can be accomplished with an investment in time, equipment, layout, new products or other similar means.

It has been observed in Contractor B that this commitment has yielded results through better productivity. However, Contractor A's results are not as prominent. This may be due, in part, to a lack of group incentive and a temporary layout, which have prevented the module from reaching all of its production, earning and quality goals.

FLEXIBILITY

Contractor A: In this plant, flexibility of the equipment in the module is not a major concern because the only product manufactured in the modular group is pants. Therefore, management can focus on the best method of manufacturing the one product, and the equipment in the line can include special machine setups and work aids indicative of pants production. For example, the line includes semiautomatic workstations for serging, J-stitching and welt pocket sewing.

Although equipment flexibility is not required by product mix, the operators still must have the ability to move freely within the module. This is accomplished through cross-training within the module.

Contractor B: Production in this plant changes from time to time, making flexibility of the equipment a necessary

attribute of the modules. Currently, the plant has been primarily manufacturing ladies' tailored blazers. However, in the past, the company has manufactured children's wear and ladies' sportswear in the plant.

For this reason, the company has decided to maintain the ability to switch garments based on customer demands. To achieve this, almost all of the equipment in the modules is single needle sewing machines. The few specialized stations that are available in the module include such universal equipment as button and buttonhole and welt pocket sewing machines.

Operators in these modules must be cross-trained to perform multiple sewing operations in order to facilitate a move within the module or a change of product.

Corollaries: It is critical that management stress the importance of the operators' movement flexibility within the module at the onset of the planning process. Flexibility should then be reinforced through cross-training and teaching the participants the principles of work balancing.

> IF MONEY IS GOING TO BE SAVED FROM REMOVING IN-LINE INSPECTION, THEN ALL OF THE OPERATORS IN THE MODULE NEED TO BE CONSTANTLY REMINDED OF THE NECESSITY FOR SELF-INSPECTION.

In Contractor B, operators who are asked to move from one module to another to help the plant-wide balance are not included in the analysis of the group balance. In this way, neither the modules nor the operator is hurt by the move. This has encouraged the willingness of operators to move to other units when their skills are needed.

In Contractor A, the operators were shown a list of operations that management felt needed additional coverage, and they were asked to pick which operations they would like to learn. The supervisor then attempts to include that operation in the operator's training schedule, but management also reserves the right to take an operation off the list if someone cannot perform that operation efficiently or has not shown progress in learning the operation.

Those companies considering the implementation of modular units and evaluating the inclusion of unit production systems (UPS) might consider multiple machine heads on turntables. When used at a workstation, these turntables can reduce the cost and space requirements of a UPS. It also increases the flexibility of the UPS module because one workstation can now function as four, depending on the system being used.

MOTIVATION

Contractor A: Prior to the adoption of modules, the operators were previously on a normal piece rate system. During the conversion, the operators were given a training rate guarantee, and this has since been modified so operators earn their piece rate and get a percentage subsidy when they move to other jobs that they know or are learning

The company is continuing to look at group incentive options to encourage more teamwork since observation and payroll evaluation have shown that the operators are not team oriented at this time.

Contractor B: All operators were paid an hourly rate before the modules were initiated. During the conversion, group incentives were added to the operators pay to increase productivity. Management is currently studying the Apparel Productivity Share modular compensation program proposed by Clemson Apparel Research, Clemson University.

Corollaries: With a modular configuration, operators can count on a full work week, or can push to complete their work in a shorter period of time and voluntarily leave early. In the case of Contractor A, the average work week went from 32 to 40 hours after the adoption of modules.

The two firms represented in this study illustrate that group incentive pay is essential for the success of the module because it encourages teamwork. Individual incentives do not work effectively as the sole component of a modular pay program. For example, at Contractor A, the individual incentive system does not encourage group interaction.

If the goal is to have operators willingly move to secondary operations for the benefit of the whole group, then the compensation system should reward that movement because it increases the productivity of the group. Individual piece rates do work, however, when balanced with group incentives that are tied to quality as well as productivity.

ABSENTEEISM

Contractor A: Absenteeism and lateness are virtually nonexistent within the modules. This is due, in part, to the location of the plant and its access by car and public transportation.

Contractor B: Lateness is a continued problem within the modules.

Corollaries: Preselection of employees is needed in a module that is not plant-wide to ensure that the group's attendance is excellent. This selection process was followed in Contractor A, however, since Contractor B converted the entire facility, this was not a relevant consideration.

There should be a published attendance policy within the company that discourages absenteeism. Some firms have found that adjusting compensation by 5% seems to be a motivator, although neither of the companies observed in this study include this 5% in compensation.

QUALITY

Contractor A: The operators at this company are actively inspecting their work and are also being audited on finished goods. Information is kept on each operator by utilizing the real-time production control system. The eventual goal is 0% defects, but with the cross-training, 3%-5% defects is the current range.

Contractor B: The operators are responsible for inspecting their own work and other operator's work, but no individual records are kept, and the actual percentage is not logged. The goal is to reach 0% defects, but 3% at packing is currently the norm. A new procedure has been installed to inspect garments before pressing, and now, repairs are distributed every hour to each group.

The concept of a zero work-in-process line, as shown above, was modified by these two contractors to fit the individual needs of each plant. Photo courtesy of (TC)².

Corollaries: If money is going to be saved from removing in-line inspection, then all of the operators in the module need to be constantly reminded of the necessity for self-inspection. In plant A, the chart on the wall and the supervisor are the reminders that quality counts. In plant B, the defective garments are hung in the middle of the floor so that everyone can see them before they are repaired.

Attention must also be paid to the quality of information within the company. With shorter lead times and less work-in-process, information processing must be quick and accurate to reduce breakdowns in production that result in quality problems. At Contractor A, this has meant the continuation of the real-time data collection system already being used for payroll and production control, while at Contractor B, the owner has moved to the floor of the plant with a telephone to expedite directly without computer interfaces.

WORK-IN-PROCESS

Contractor A: Throughput time has been reduced by 66% with the modules, with the ultimate goal of the company being a 75% reduction of throughput time. In addition, the absolute volume of work-in-process has been cut by 75% for this particular pants line. The ultimate goal here is to have one day of work-in-process in reserve between shade marking and the line. Currently, there are normally about 10-18 pieces between each operation.

Contractor B: Throughput time has been cut in half. There was no initial goal set, and this level is meeting the company's needs. If needed, a cut may be entered into the line in the morning and the finished product can be shipped that same afternoon. At times, work-in-process has been cut to one piece between operations, though the norm also is usually 10-18 pieces.

Corollaries: Being able to produce in the Quick Response business environment is undoubtedly one of the biggest benefits of modular manufacturing, but it puts additional stress on management and the support network as they are called on to make decisions quicker. Both of these companies have been able to significantly reduce throughput time to provide faster turnarounds for their customers.

Contrary to what these companies initially expected — lower levels of production — both firms have what appears to be a 20%-25% higher level of sales. It was not possible to analyze the manufacturer-retailer exchange as a part of this project, but it is relatively safe to assume that faster turnaround, competitive costs and high quality are all favorable qualities that have led to repeat business.

SUMMARY

Work-in-process levels are going to cause the next computer revolution in our business environment. Information must be on hand in order for us to make timely decisions with confidence. There is an increased need for supervisor, management and owner training in the functions of computers and learning how to analyze data.

Before we move into CIM technology and the possible introduction of artificial intelligence, we need to upgrade our understanding of how we can interact and use computer technology today. Modular manufacturing will force this issue to the forefront, as production runs will be shorter, with more variety. Hopefully by examining the different companies taking on the challenge of flexible manufacturing, we will be better prepared to face the challenges the apparel industry faces. Every company needs to address these new possibilities from an individual perspective, however, it is possible to learn from the ideas initiated by other companies. ■

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